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PYROGRAVURE.

PYROGRAVURE is a new process of engraving, essentially French in its origin and development, and which, although not offered as a substitute for any of the processes employed in decoration, happily puts at the disposal of the decorative and industrial arts new and varied resources whose multiple applications it is as yet impossible to foresee. This process, which is due to M. Manuel Perier, consists in tracing, by means of an incandescent point, upon wood, leather, bone, ivory, fabrics, etc., designs which, varied in tone, depth and tinting, through a carbonization more or less complete and more or less pronounced, produce extremely varied and remarkable effects in the hands of the artist.

This process permits the artist, without apprenticeship and without useless tentatives, to execute an ineffaceable decorative work, created directly upon the object to be ornamented. The first experiments of Mr. Perier date back to 1869. The idea of them occurred to him on observing the shipment of boxes of wine marked with a branding iron. He tried to reproduce the sepia tints made by the application of the branding iron, through red hot pokers. At first he obtained nothing but shapeless outlines. Neither did the points used since the time of Ambroise Paré give any better results, for they cooled very quickly, and did not permit of making a line equal either in depth or color.

He obtained better results with the small soldering irons used with gas, and especially with a platinum wire kept incandescent by the passage of an electric current; but, at the epoch of those experiments (1874), accumulators were as yet not common, and Mr. Perier did not continue his experiments in this direction, although they could now be resumed with more chances of success.

The true solution of the problem, consisting in keeping the incandescent tracing point, designed to produce the carbonization of the object to be decorated, incandescent for an indefinite length of time, and always at the same temperature, was given to Mr. Perier by the thermocauter invented by Dr. Paquelin, in 1875. The principle of the Paquelin thermocauter, which is so frequently used in surgery, consists in injecting air charged with the vapors of a hydrocarburet into a platinum tube. If the tube has previously been raised to a certain temperature, the air and hydrocarburet will combine in the tube, and the combustion of the mixture will maintain the temperature indefinitely, as long as the injection of air continues.

In surgical operations, the working of the apparatus lasts but a few minutes, and the air is injected with a Richardson bulb. Mr. Perier has modified the thermocauter and the method of using it, so as to permit of working continuously for several hours. The pyrogravure apparatus, devised by Mr. Perier, consists at present of three principal parts, viz., an air reservoir, a carbureter and a thermo-tracer.

The air reservoir consists of an iron plate cylinder, C (Fig. 1), which enters an annular receptacle, A B, so as to lighten the apparatus. This cylinder, which is lifted in order to fill it with air, contains enough of the latter to last for an hour's work. It suffices, then, to raise it once per hour, an operation that may be performed without much labor. While it is being raised, the air enters through the valve, E. The cylinder descends by its own weight and exerts upon the air a pressure that may be made to vary within certain limits by charging the cylinder with weights that vary in heaviness according as it is desired to give the thermo-tracer a more or less elevated temperature.

The air compressed by the cylinder escapes through the tube, J (Fig. 1, No. 2), and divides into two parts. One of these enters the carbureter, D (which consists of a vessel containing a sponge saturated with a hydrocarburet—alcohol, wood, naphtha, benzine, etc.), makes its exit at K, and reaches the thermo-tracer through a very flexible rubber tube. The other portion of the air flows directly to the tracer, in order to keep its handle cool. To this effect the thermo-tracer is provided with a hollow wooden handle, around which circulates the air forced directly by the reservoir, and the discharge of which is regulated by a cock situated above the carbureter, so as to prevent waste, and yet at the same time to assure sufficient cooling. The thermo-tracer is a simple metallic tube, to which is screwed the platinum tube, H, raised to incandescence. The enlarged part contains an aperture through which escapes the products of combustion, which latter takes place at the pointed extremity of the platinum tube.

Tracers of varying sizes and contours can be screwed on, according to the nature of the work to be done, and the effects produced may thus be varied.

Fig. 2 represents an artist in the act of making a pyro-engraving. We may see here how easily the tracer (which is scarcely larger than a pencil) is maneuvered. The two rubber tubes which end at its extremities are so light that they in nowise interfere with the handling of it. The results are varied *ad infinitum* with the taste and skill of the operator, the nature of the substance and its coating, the temperature of the tracer, etc. Having described the *modus operandi*, let us briefly examine the applications to which the process lends itself.

Pyrogravure may be utilized as an accomplishment or simple pastime by young people and amateurs, whether they do or do not know how to draw. It suffices, in fact, to transfer, by any process whatever, a drawing or ornament to a panel in order to pyro-engrave it with the greatest facility and very quickly obtain encouraging results.

Art, decoration, and industrial ornamentation have in pyrogravure a new and practical means of utilizing

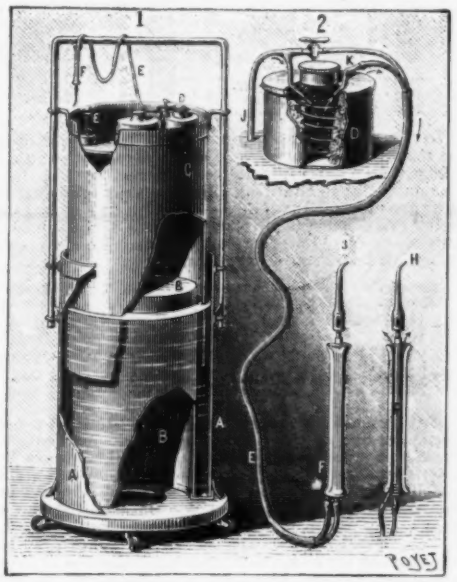


FIG. 1.—PYRO-ENGRAVING APPARATUS.

1. Air reservoir. 2. Carbureter. 3. Thermo-tracer.

the talent of the artist and the skill of the workman. We may be convinced of this by taking a glance at the specimens now being exhibited by Mr. Perier or in course of execution at the Exposition of Sciences and Industrial Arts in the Palace of Industry. We may mention in the first place the large poplar panel which forms the sign of the little studio wherein the inventor daily demonstrates his process to visitors. The decoration of this panel was the first decorative work of the kind that was done on the spot in the exhibition. Among the thousand and one objects already pyro-engraved, we remarked glove and handkerchief boxes, small utensils, paper knives, umbrella handles, mouldings, fabrics leather, etc. Pyrogravure combined with the art of projection permits of reproducing a given drawing upon a panel of any size whatever, and Mr. Perier's exhibit offers an example thereof in the reproduction of a drawing of Detaille's upon two panels of very different sizes. What we have just said suffices to show that cabinet making, carpentry, artistic book binding, and the manufacture of leather for chairs and hangings will find curious and interesting decorative resources in pyrogravure.—*La Nature.*

FIG. 2.—MODE OF USING THE APPARATUS.

IODINE AS A DETECTIVE.*

M. G. BRUYLANTS recently communicated to the Academie de Medicine de Belgique the results of a series of interesting researches made on the means of recognizing certain accidental or fraudulent alterations of paper and writings. Outside of the importance presented by these researches for legal chemistry, they show some characteristic and curious properties of certain papers' qualities, on which attention was not directed until to-day.

M. Bruylants had observed for a long time that dry paper exposed to the vapors of iodine takes a different tint to any other sample of this same paper dried after having been moistened. Having made preliminary experiments in this direction, the author demonstrated the following facts:

When paper, sized and calendered, is partially moistened, then, after drying, subjected to the action of iodine vapors, the parts which have been wet assume a violet tint, while those which have escaped the water grow yellow or brown. The intensity of these colorations naturally varies with the time of exposure to the iodine. This phenomenon is again very clearly produced when drops of water are let fall on paper, and that, after having allowed the water to evaporate on the spot so as not to change the surface of the paper, this last is heated at 100 deg. to thoroughly dry. If the paper thus prepared is saturated with water, the parts which were first wet become violet blue of great intensity, while the dry parts become blue.

When a piece of paper is completely wet, on to which some drops of water have been previously let fall and then evaporated, if it is then dried and next subjected to the action of iodine, one can still manage to distinguish, either on the dry sample or by wetting it again, the parts on to which the first drops fell.

In this last case, that is to say in wetting, as long as the paper remains damp the place of the first drops is hardly distinguishable, but when the paper is again dried their geographic outlines, very much faded, are clearly discernible on the darker surface, thus limiting in a marked manner the position of the first drops.

One can by means of this reaction produce a sympathetic writing; it suffices to trace characters with water on paper sized and rolled. These last will appear with perfect distinctness when the dried paper is exposed to the action of iodine vapor. The violet brown shade on a yellowish ground will turn pale blue after damping. These characteristics disappear at once under the action of sulphurous acid. They again reappear after a first decoloration, provided that the paper has not been wet, and that this decoloration has been made with gaseous sulphurous acid. One could then by means of this process trace characters which would become legible and disappear at pleasure to reappear again, or again which would serve a single time and disappear altogether.

Generally they examine, to see whether the paper has been rubbed, by transparency or transmitted light. If the rubbing has been strong, so as to take away part of the material, the paper presents, in this point, greater translucence; every one has verified this fact. When the rubbing has been carefully performed, it is sometimes also discovered, by examining it by transmitted light, the rubbed part is duller than the rest, which results from this, that the work has produced a partial coating of the fibers of the paper. If, instead of employing gum, bread crumb is used, if the rubbing is performed in the same direction, the result of this action may escape notice; most frequently it will be impossible to verify it when on paper thus treated characters are traced with ink or pencil.

Iodine vapor brings out the details of these manipulations in a marked manner; it limits the position with absolute distinctness. The parts rubbed turn brownish yellow or violet brown. When wetted after ioduration, a partially rubbed paper turns blue, the intensity of which varies with the time of exposition to the iodine, and when the paper is dry one sees that the parts rubbed are more or less dark than the others. When the paper has been strongly rubbed so as to produce the carrying off of a notable part of the material, the traces of rubbing appear after exposure to the iodine, damping and drying with less intensity of coloration, because in these conditions the mechanical action of the rubbing of the paper, by taking away a portion, has also caused a part of the substance (starch size) to disappear, which, by combination with the iodine, produces the blue tint, so that the greater or less intensity of the rubbing gives, under the action of iodine, quite opposite effects.

When a piece of paper partially rubbed is damped

* Translated from the *Revue Scientifique* of January 17 1891.

in the conditions in which this operation is performed, to copy with the press characters there found, if then it is allowed to dry thoroughly and subjected to the action of iodine vapors, the phenomenon is again produced, but the shades are less marked. If the paper thus treated is damped, the parts rubbed appear, after perfect drying, paler than the rest of the paper. It is then pretty much the same for rubbing and wetness. Iodine also permits, in certain cases, the detection of the nature of the substance employed for the abrasion —bread crumb or gum. The traces of rubbing with gum appear yellow or brownish yellow after ioduration, and more deeply colored streaks are distinguished for rubbing. With bread crumb the paper sometimes takes a violet shade, and always more uniform. These phenomena are caused by the facing of the fibers of the paper produced by the rubbing. For an equal extent there is in reality, thanks to this facing, a greater absorbing surface; a greater proportion of iodine can then be fixed on the parts rubbed than on those which have not been.

When characters are traced with a soft point—for example, a glass rod with a perfectly rounded extremity—and the paper exposed to the action of iodine vapor, these characters soon appear brown on a yellowish ground, which damping turns blue. This phenomenon is again produced when the paper on which the tracing has been made is calendered. If one is careful not to wet the paper, these characters can be made to disappear, and appear again by the successive action of gaseous sulphurous acid and iodine vapors. This reaction excels with writing with distilled water as ink, or rather as sympathetic writing. Tracing with the glass point is little apparent, especially when made between lines of ink writing. The reaction, moreover, is so sensible that one can still produce it by tracing the characters on a piece of paper under which a second has been placed; they then appear very clearly on the latter when physical examination would in nowise enable the establishment of their existence; it suffices for that to expose somewhat lengthily to the iodine vapor. To obtain greater intensity one can, by tracing the characters, place the two fragments of paper superposed on a hard substance—slab of marble, glass, or porcelain. The explanation of this phenomenon is to be sought for in the fact that under the pressure of the soft point a settling of the substance forming the sizing has taken place, so that in the presence of a greater quantity of this substance the iodine can produce a deeper coloration.

If the side of the paper opposite to the one on which the characters are traced is exposed to the iodine, these characters appear but topsy-turvy. This last verification has suggested the idea to M. Bruylants of endeavoring to reproduce with iodine characters traced with the pencil which have been rubbed out. In addition to the plumbago left by the pencil stroke, the latter has produced a settling analogous with that produced by a soft point.

When pencil characters are effaced with care, so as not to damage the substance of the paper, and the rubbed part exposed to the iodine vapor, these characters sometimes disappear. If the abrasion is made with greater force, so as to take away part of the substance of the paper itself, it is impossible to restore to these characters their primitive form so as to make them legible. But even in this last case, if one exposes to the iodine vapor the side of the paper opposite to that on which the characters have been traced, and on which the abrasion has been made, one sees the characters reversed which were taken away, and that in a sufficiently distinct way to read them easily, especially when the writing is turned by placing the piece of paper before a mirror. Sometimes, even when the writing by a pencil is sufficiently marked, these marks are successfully reproduced by the copying press. For this the action of the iodine is protracted somewhat, a calendered and sized piece of paper is damped in the ordinary conditions for press copying.

The clearness of these reactions naturally depends on the species of paper employed; slightly sized and slightly calendered paper does not present them; in addition besides, by subjecting the imprinted paper to such manipulations which it seems superfluous to give here, one may prevent the production of the phenomena described. One should ask one's self also, For how long does the paper preserve the property of producing these reactions? According to M. Bruylants, one can still clearly establish that paper has been irregularly damped or rubbed three months previously, and one can at the end of the same time make characters legible traced with a soft point. These reactions are better produced when the imprinted paper is placed for three to six hours over a basin containing water. Nevertheless, although very characteristic, these reactions are much less intense than when the manipulations are recent, perhaps even they are no longer produced after a time more or less long, according to the greater or less strength of the impression.

However it may be, for the expert who has to study forgery and fraud in writing or paper, meeting with very great difficulties most frequently, it is useful to draw attention to the reactions observed and described by M. Bruylants.—*Translated by Br. Jour. of Photo.*

CINEREINE.

THIS is a new color sent out by the Societe Anonyme des Matieres Colorantes de St. Denis, better known to English dyers as Poirriers. This dyestuff can either be dyed on mordanted cotton or it may be dyed direct. In the former case the best method of dyeing is to first mordant the cotton in the usual way with tannic acid and tartar emetic. The actual dyeing is started cold and worked for about 20 minutes, then slowly heated up to the boil and continued at this heat for about ten minutes; then the goods are wrung, aired for half an hour, and fixed in a weak bath of bichrome, about 4 lb. in 100 gal. of water. When used as a direct dye about ten per cent. of hyposulphite of soda is added to the bath, after which they are fixed with bichromate as before. The shades obtained by both methods are almost identical, the direct shades being slightly bluer in tone.

With half per cent. of color a pale silver gray is obtained, with one per cent. a medium shade of gray, with three per cent. a dark gray slate. The shades are turned blue by acids, whether dilute or strong, while caustic soda turns them a reddish shade; on the other hand, they resist perfectly a strong soaping without bleeding, which is a good point and makes this product of use for dyeing grays. It can be combined with any of the basic colors, and with cachou de laval of the same makers, resulting in the production of a variety of useful shades. The dyestuff itself is in the form of a gray crystalline powder, only slightly soluble in cold solution; it is also soluble in alcohol and acetic acid to violet solutions. Acids have no apparent action on the aqueous solution. Strong sulphuric acid dissolves it to a dark violet solution, which on diluting with water turns to a blue violet. Caustic soda throws down a red violet precipitate from the aqueous solution.—*Dyer and Calico Printer.*

[SIDEREAL MESSENGER.]

A PERPETUAL CALENDAR.

R. W. MCFARLAND.

IN the year 1848 I came into possession of a perpetual calendar, found in an old book, and copied it off for further examination. It was somewhat different from this, but really involved the same principle, but there was no hint of the way to construct it. But this was made manifest by the following procedure, which underlies all styles of perpetual calendar. Begin by setting down in tabular form the new year days:

Say 1891 began on Thursday.		Trace a few years in reverse order:	
1892 will begin on	Friday.	1890 began on	Wednesday.
1893 " "	Sunday.	1889 " "	Tuesday.
1894 " "	Monday.	1888 " "	Sunday.
1895 " "	Tuesday.	1887 " "	Saturday.
1896 " "	Wednesday.	1886 " "	Friday.
1897 " "	Friday.	1885 " "	Thursday.
1898 " "	Saturday.	1884 " "	Tuesday.
1899 " "	Sunday.	1883 " "	Monday.
1900 " "	Monday.	1882 " "	Sunday.

In this way a whole century can in a few moments be regularly arranged, and 15 or 20 centuries in a few hours. As a general rule each succeeding year begins one day later in the week; but the year following leap year goes forward two days—the 29th day of February being one of them. Suppose one has set down 20 centuries, say from 1500 to 3400 inclusive. The centesimal years fall into groups as follows:

Begin on Monday.	Begin on Saturday.	Begin on Friday.	Begin on Wednesday.
1500	1600	1700	1800
1900	2000	2100	2200
2300	2400	2500	2600
2700	2800	2900	3000
3100	3200	3300	3400

But here are 20 centuries, and the centesimal years all begin on one of the four days given. No centesimal year, new style, ever began or ever will begin on Tuesday, Thursday or Sunday. The table may be extended indefinitely both forward and backward. In like manner commencing anywhere, say at 1800, let the new year's day for a century be gathered up in tabular form. Besides 1800, the following years also have Wednesday for new year's day (omitting the 18 for convenience), 6, 12, 17, 23, 34, 40, 45, 51, 62, 68, 73, 79, 90 and 96. Other groups begin on Thursday, Friday, etc.

Having every fourth year (old style) a leap year, the centesimal years will run through the whole week. If those beginning on Sunday be put in one column, those on Monday in another, etc., there will be seven columns. But it is not necessary to repeat the rather tedious course of putting down the new year's day for twenty centuries. The following course is short and simple. It is seen above that 1800 began on Wednesday, but in January of that year the difference between old style and new was eleven days, old style lagging behind. Then count forward eleven days from Wednesday, and you find Sunday for Jan. 1, 1800, old style. In like manner 1700 began on Friday, new style; but the old style on that day was ten days behind—add ten days to Friday—and you reach Monday. So 1600 began on Saturday, new style, and then the difference was ten days; count forward ten from Saturday, and reach Tuesday for old style. Bringing the years together, we find

1600 begins on Tuesday, old style.
1700 " Monday, "
1800 " Sunday, "

1900 will be Saturday, each centesimal year in order falling one day earlier in the week—so that twenty centuries may be set down in a few minutes.

In order to bring both styles into the same table, a sliding to the right is made of one day for each of the centesimal years which are common years. But they are properly arranged in the general table given below. The days of the week, the days of the month, and the months themselves are arranged in due order, making the calendar complete for both styles and for all time.

About the year 1859 some one who had seen the old calendar above spoken of, or who had made an independent investigation of the subject, wrapped the table round a cylinder, and with a movable collar containing the days of the week and the twelve months took out a patent as I have heard. The cylinder is by far the most convenient form, but is not on the market, and so far as I now remember, it was sold only at private sale by its originator.

ASSOCIATED JOURNALISM.*

By PAUL WILCOX.

MY subject gives no opportunity for a philosophical consideration of the province of journalism, nor chance for oratorical flights on the deeds and possibilities of the press. Much less does it afford scope to treat of the abuses of the newspaper. Nevertheless, my audience may have cause for congratulating itself in being spared the infliction of any philosophy: for did not a sage remark that "Philosophy triumphs easily over evils past and evils to come; but present evils triumph over philosophy"?

Equally glad you probably are to escape the plague of oratory; most fortunate are you to avoid the diatribe of the critic. Byron wrote: "Believe an epitaph, or any other thing that's false, before you trust in critics."

By this time, it is evident that I am seeking consolation in being deprived of the pleasure of argument and spread-eagleism.

In describing one feature of the mechanism of modern journalism, I will tell how the average newspaper comes into being, and will not treat of the large metropolitan journals.

The construction of the modern average newspaper has followed that universal law—development. By average newspaper is meant that vast number of papers that have a local existence and influence, and which are scarcely known outside of their particular localities, in contradistinction to the few great journals whose homes are in the great cities, but whose prestige is nation wide. Needs and their solutions work slowly together. It is only a few years ago that we remember the country editor as the universal butt of current fun. His lot was an unenviable one. He was political prophet, religious teacher, local poet, musical critic, agricultural adviser—he was for his readers an encyclopedia—but such an encyclopedia! He might have been pirated without the slightest fear of copyright suits. In fact, he was more than all these. He was business manager, advertising agent, mailing clerk, and with a small devil—I mean a newspaper devil, a body as innocent and beatific as a boy can be—he set the type for his paper, and ground the crank of the press that printed the expressions of his diverse genius. As business man, we all recall how he collected his subscriptions in local provender for his household necessities. Apples, potatoes, turnips and cord wood were better known to him as mediums of exchange than the coin of the nation. In short, he was a factotum of universal knowledge and work. The quality of his knowledge and work are well known. The man who was compelled to collect his bills in chickens and cabbages was ill fitted to discuss politics. He who was harassed with the hard labor of type setting was not qualified as religious adviser or literary critic. The meager earnings eked out of his paper barely sufficed for existence. The problems of government, the questions of sociology, the trend of religious thought, the standards of criticism, were things beyond his ken. The great papers alone could discuss these questions. His readers were furnished with letters from Mt. Carmel and Muddy Creek township; but no bright observers in the world's capitals sent him accounts of the march of humanity. Even the poor fellow could not use his scissors well. His mind was so dwarfed and narrowed that the good of the great papers could not be appreciated. Nor was the country editor entirely alone in this dire plight. Hundreds of editors throughout the United States were, to a certain degree, likewise situated. Even in cities of goodly proportions, the small daily paper had a bitter struggle, and was frequently an injury to its readers. The editor had no funds to purchase a telegraphic report of the world's doings, nor could he hire a competent staff to edit the various departments of his paper.

Such a state of journalism was not and could not be an efficient force in moulding right thought and imparting true knowledge. It was the cause of a marked distance between the worth of the great journal, with its fine staff of editors and correspondents, and the mass of smaller papers. A solution of this evil—for such journalism is an evil—has been effected, and a revolution accomplished in behalf of the weak papers. They have been enabled to reach a quality but little inferior to the great journals. The editor's life has been made easier, and the cause of journalism much aided. This last assertion may have its opponents, but, as I have no antagonist to annihilate my dogmas by the power of his logic and eloquence, I will state my convictions, letting the whys and wherefores care for themselves.

This beneficent change in behalf of the editor and his paper is, to a great extent, the result of associated journalism. There arose organizations in the United States whose business was that of newspaper purveyors. They furnish papers not only telegraphic news, but every species of reading matter—from politics to poetry, from religious opinion to agricultural points, from scientific views to sporting items, from stock market reports to Sunday school lessons, from historical thought to shopping notes, from long novels to gossipy chitchat. The work touches all sides of human life. These companies have large offices scattered throughout the United States, so located that

* From a recent address before the Outlook Club, of Montclair, N. J.

	Old Style.	New Style.		
4 9 15 20 26 **32** 37 43 48 54 **60** 65 71 76 82 **88** 93 99	etc. 600 1300 2000 2700		1, 8, 15, 22, 29	Sun	Jan., Oct.
3 8 14 **20** 25 31 36 42 **48** 53 59 64 70 **76** 81 87 92 98	etc. 700 1400 2100 2800	1700 2100 2500 etc.	2, 9, 16, 23, 30.	Mon	May
2 **8** 13 19 24 30 **36** 41 47 52 58 **64** 69 75 80 86 **92** 97	etc. 100 800 1500 2200 2900		3, 10, 17, 24, 31.	Tues.	August
1 7 12 18 **24** 29 35 40 46 **52** 57 63 68 74 **80** 85 91 96	etc. 200 900 1600 2300 3000	*1600* 2200 2600 etc.	4. 11, 18, 25	Wed	Feb., Mar., Nov
0 6 **12** 17 23 28 34 **40** 45 51 56 62 **68** 73 79 84 90 **96**	etc. 300 1000 1700 2400 3100		5, 12, 19, 26	Thur.	June
0 5 11 16 22 **28** 33 39 44 50 **56** 61 67 72 78 **84** 89 95	etc. 400 1100 1800 2500 3200	1500 1900 2300 2700 etc.	6, 13, 20, 27.	Fri.	Sept., Dec.
4 10 **16** 21 27 32 38 **44** 49 55 60 66 **72** 77 83 88 94	etc. 500 1200 1900 2600 3300	1600 2000 2400 2800 etc.	7, 14, 21, 28.	Sat.	April, July.

where the reach of one office ceases, the reach of the other begins. They form distributing centers, from which are sent to local papers these various kinds of reading matter. Naturally the distribution of matter is so regulated that no two newspapers in the same town or city, nor two papers conflicting in circulation, receive the same articles. This question of conflicting circulation, though it may seem of consequence, amounts to little. It is only the few great journals of a few great cities that have a wide reach. Even the omnivorous newspaper fiend rarely reads the papers of such sized cities as Albany, Buffalo, Detroit, Kansas City, and many other like places. Much less does he know of the *Heralds*, *Banners*, *Republicans*, *Democrats*, *Stars*, and *Presses*, of country towns. Yet these little fellows number thousands, and their local thunderings are of great importance in their communities.

Associated journalism is an organization of minute detail, and the most perfect system.

The company whose work I am acquainted with has its editorial, manufacturing, and business departments. Each is many times subdivided. It has its various editors, like any great newspapers—only they are more numerous, and their departments more diverse. Each department has its chief, whose duty it is to secure wherever he can the best articles from the best writers on the particular subject under consideration. Let me illustrate: There are the political editors, Republican and Democratic, also Prohibition, and any other exponent in politics whose views are demanded by the public. The Republican editor secures the views of leading Republicans on the current issues, viewed from a Republican standpoint and biased with all that religious partisanship which humanity loves, notwithstanding its protests. He may be even bigoted, and proclaim everlasting damnation, destruction, and consequent chaos, unless Republicanism prevails. You may know some pygmy-minded people who must be fed on such rant. There are many such. The Republican editor interviews Republicans of prominence, gives sketches of their lives. He quotes leading Republican papers, and doses his readers with allopathic Republicanism. This Republican matter is then sent out from the various distributing centers to small Republican papers. The little paper prints well written, well selected, well edited Republicanism. The quality of its Republicanism equals that of the best papers of the party. It is far superior to what the little paper formerly furnished, since the editorial work and the interviewing are done by high-priced talent and by editors whose sole business is Republicanism, and who are removed from the universal drudgery of the small editor. When it is known that hundreds of papers get this same matter, it can be seen how high-priced talent can be employed. However, associated journalism has no politics. Its motives are the pure ones of imparting culture, elevating tone, and promoting high class journalism. I refrain from mentioning any minor monetary considerations. Having no politics, what it does for Republicans it likewise offers Democrats. It provides our Democratic patriots with individual liberty, State rights, free trade, and other necessary party food. This nourishment is prepared by the best culinary artists of the Democracy, flavored with the strongest Democratic condiments, and is then fed to hundreds of Democratic papers throughout the length and breadth of the land. It has been the wont of both Republican and Democratic State central committees to conduct part of their campaigns with the aid of this associated newspaper plan. Their work is far more effective. One intelligent editor, under the advice of the central political committee, presents to readers a more accurate and telling statement of the issues. Moreover, some editors have been known not to see the vital questions under discussion. Associated journalism is equally kind to our Prohibition friends.

The secular paper is required to furnish religious thought and teaching. Religious sentiment is a part of American inheritance. Though the average editor may re-echo political cant, yet he is not ordinarily a heavy weight in religious philosophy. Associated journalism employs men fitted to give the religious trend of the day. It furnishes a weekly sermon, preached by some noted divine. It will not be amiss here to state that Mr. Talmage's sermons have a hold on the mass of newspaper readers such as is not possessed by the work of other divines. Associated journalism, as all work, is necessarily governed by the principle of demand and supply. What the readers demand, the paper must supply. No paper can run and shoot over the heads of its readers. People are educated slowly, although our company has tried to lead thought by pushing the sermons of many of America's great preachers; in each case the efforts have proved fruitless. Talmage reigns supreme. His sermons and his alone have a large weekly sale to secular papers. Speculation as to what duty is is ever rife. The average business concern of the present does not long conduct great reforms at great financial loss. I am glad to express my faith in the right views of the majority. It loves true effort and will not tolerate low ideas and tastes. The majority may not always appreciate the best, but it will not tolerate the base. It is interesting to know that Mr. Talmage prepares his sermons several weeks in advance. They are then distributed to various papers throughout the country, and are set in type and ready to be printed before Mr. Talmage delivers the sermon. Thus, the sermon that Mr. Talmage preaches in Brooklyn next Sunday is already in type, in the hands of the San Francisco publisher, and will be printed on Monday morning. Should for some reason the particular sermon not be delivered, or no sermon at all, the religious editor of the company sends a telegram to his sermon customers, saying, "Don't use Talmage."

A large field of activity for associated journalism is that of correspondence. The correspondence editor has special letter writers throughout the world. To him, these bright observers send their breezy letters, and he in turn distributes duplicates to many newspapers.

One of the most important and one of the most neglected departments of a newspaper is that of its miscellany. It is the padding, the trimmings of the paper. It is to a newspaper what the silk lining is to the lady's dress skirt. To know what is good reading and what will interest the reading public takes an acute and discerning mind. Men who ride hobby horses, or canter on special highways, have not enough breadth to keep in touch with all sides of human life. Hence, the difficulty of finding an editor who can clip well. Associated journalism makes this a specialty, and furnishes each week columns upon columns of well chosen miscellany. Local papers can make selections for their own use out of the great quantity. What has been said about political, religious correspondence and miscellaneous matter is applicable to almost every line of thought. Literary, financial, fashion, sporting, and humorous editors are all at work preparing matter for thousands of readers. The necessity of associated journalism and its method of preparing matter to supply that necessity having been partially scanned, the means of distributing the matter and its cost demand attention. This leads to a consideration of the manufacturing and business sides of associated journalism. However, before leaving the editorial department, I want to tell of the clipping work. Each editor is supplied with the various papers and magazines that bear in any way on his special line. When he reads these exchanges and sees anything that may be of future use, he marks it with his blue pencil, or should he see some article particularly applicable to some fellow editor's work, it is likewise designated. Boys cut out these marked articles, which are then indexed and filed away under their proper headings, making a repository of contemporaneous thought on the subject, and an inexhaustible mine for reference in working up new articles on the same subject.

For example, when General Sherman died, a few days since, all that leading papers have said during the past ten years about the famous general could have been found under the heading Sherman. In this way every detail about a man or an event is kept track of. Newspapers go so fully into life nowadays that accounts of what General Sherman ate and smoked, what kind of hats he wore, the prevailing color of his trousers, a minute description of his nose, the size of his boot, the shape of his ears, as well as an exhaustive statement of his career, could have been found in these clippings. Even photographs and cuts of people and places are kept in the same way. If any one of my audience is in any way distinguished, if you will go with me to-morrow morning, I will show him a far more exhaustive account of himself than you could possibly give, because the carriage of your head and the blink of your eyes may have escaped your particular notice, but rest assured that some young reporter has marked these things, and his descriptions I will show. I will show you pictures of yourself, good, bad, and indifferent. Pictures of how you looked in long hair, and how you looked in short hair, pictures of yourself in babyhood days, and pictures of mature years, pictures of how you wear your hat and carry your cane, pictures of yourself in every conceivable way that you ought to appear, whether you are ever seen that way or not. In short, in two minutes after entering the clipping room to-morrow morning I will read you more about yourself than was ever dreamed of in any philosophy, and will show how you looked from babyhood to manhood, and how you are expected to look in old age. Associated journalism is, as you see, a storehouse of universal newspaper matter, ready to be supplied to customers.

The distribution of this newspaper material is a novel feature of associated journalism, and involves its manufacturing side. All the matter is set in type, just as is done by any newspaper. A papier mache impression of the type is then taken. This papier mache mould is put into an iron casting box, into which is run molten metal. This metal cools rapidly and becomes a thin metal cast of the original type. These metal casts can be printed from the same as the type, and can be made in endless number and at great rapidity, as the papier mache mould is not injured by the molten metal. It is like making bullets, when the mould is ready you can turn them out as long as the lead lasts. These thin metal casts are forwarded from the distributing centers by express to the local papers. They can be cut into any desirable length, so that the editor of the small paper takes to his press room the matter all ready to be printed instead of having to supply manuscript to his compositors to be set in type. If the whole article he receives does not suit him, he cuts it up and uses what his fancy dictates. They can be used exactly as manuscript articles could be. They are better in the quality of their matter than small papers can produce, as has been seen, and they result in saving time, expense, and labor. The production of daily news plates is a matter of peculiar interest. Telegraphic reports are received by the news editor of the company, as they are by the great papers. Up to four in the afternoon he receives these telegrams and prepares his telegraphic page for small daily papers. At 4 o'clock the last item is put into type and these thin metal casts are then made, packed into boxes, and by 6 o'clock are on the trains speeding toward the paper that is all ready to go to press, save the news columns which these plates are to fill.

A messenger awaits the arrival of the train, gets his box of casts and hurries them to his paper. All is ready and soon the paper is on the streets. Country dailies usually go to press about 5 A. M., so that these metal casts can go long distances before it is necessary to use them. Casts made in New York city can easily go a long way beyond Albany and still be in time for the daily paper. However, there is a gap in the news between four in the afternoon and five next morning, when the small daily goes to press. This is supplied by skeleton telegrams of important events, sent out by the company's night news editor. These telegrams must, of course, be set in type by the small paper, but they contain only the bare facts, while the casts contain full details. They and the casts make a complete record of the twenty-four hours doings of the world. Likewise news plates or casts are sent out on early morning trains containing full details of all news from 4 P. M. of the previous day. These casts are intended for afternoon dailies. From New York city alone one company sends news casts to 75 daily papers. And what is done in New York is done in Boston, Philadelphia, Pittsburg, Buffalo, Cincinnati, Chicago, St. Paul, Omaha, Atlanta, and other cities. Where the reach of one office ceases, the reach of the other begins.

Could this little descriptive effort have assumed the dignity of an essay, I should have called my first, the need for associated journalism, my secondly, its development and method of producing matter for publication, my thirdly, the means of furnishing the matter, and my fourthly, the cost. Whether plebeian or not, the American man and woman are keenly alive to prices, and like to hear about them. That English critic, Sir Lepel Griffin, who had us up in arms a few years since, said we esteemed things good or bad by the measure of their cost. When shown the Madison Square Theater drop curtain, he was not asked to admire its embroidery, but was told its great cost—which was the point of interest. I will be "shoppy" and talk cost, for in this case it is a matter of surprise to the uninitiated. I hold in my hand the proof-sheet of six columns of well-selected miscellany, containing six illustrations. To produce these six columns cost the company the salary of a fine miscellany editor; the cost of having the matter set into type, viz., $10; the cost of the drawings, $4 each; the making of the cuts and the manufacture of the metal casts. The whole six columns are sold to small papers for $2, or 33 cents per column. The company employs one writer for whose weekly letter, less than two columns in length, it pays $150. It puts that letter into type, along with enough other matter to make six columns, and sells the whole to papers for $3. Mr. Talmage's sermons cost the price paid to Mr. Talmage, the price of composition and production of the casts. It, together with enough other religious matter to fill six columns, is sold for $2. Frank R. Stockton's "War Syndicate" cost the royalty on the story, say $600; to put the columns into type cost $60; the whole columns ready to print from are sold to papers for $9. Pages whose production cost the company hundreds of dollars are sold at from $1 to $2. The company gets its profits out of the large sales. It does business with over 6,500 in the United States. Their demands for matter are as diverse as the intellectual development of the editor and his readers. I will not go into business details further than to say a record is kept at the central office of every customer, and of exactly what kinds of matter he is buying. Thus the company keeps in touch with the masses of American life.

This system of journalism smacks of the ways of large miscellaneous stores, of wholesale jobbery in literary wares. This grist mill of matter suggests that famous story of the painter who produced the same picture in duplicate, by the yard as it were, and sold it to each member of a certain club. The critic especially deplores the loss of individuality. The defender of this system answers that the greater scale upon which any institution can be conducted, the better the results. Great monopolies have been greater blessings to humanity than they have been evils, notwithstanding the howl of the demagogue. Minute details receive attention, labor is more thoroughly subdivided, money more plentiful for the accomplishment of any desired end.

The editors of associated journalism are specialists and devote their time to their particular departments. Their work bears the most marked individuality. Few great papers can afford so many high priced men in charge of so many various departments as associated journalism employs. The reason is plain. Associated journalism is the editorial staff of hundreds of papers which contribute toward its pay. The supposed loss of individuality in the small paper would be a gain to humanity in most cases. The cantankerous ravings of many wishy-washy blatherskites would be replaced by truthful utterance. Weak vaporings would give way to solid reasoning—ignorance to education. True, no one points to a particular policy and says that is the plea of associated journalism, as one points to the London *Times*, the New York *Tribune* and the New York *Times*. However, silent influences are as potent in this world as the heralded cries of the renowned. But the criticism of lost individuality falls before the facts. The once overworked and harassed editor has journalism so simplified that effort which under the old system was distributed over every line of work is now concentrated. Under associated journalism he can devote his time to local news, and to writing editorials on topics of home interest, and general politics if he chooses. The associated press may be likewise said to have destroyed individuality, because it furnishes all its papers with the same news, and no single paper now gathers its own news items. Whereas this may be partially true, yet the associated press has been a blessing to the American newspaper and its readers. It gives to the many what the very few could afford, and does it better than the few could do. Just such a work associated journalism is doing for the mass of American papers in supplying them a first class editorial staff, however, leaving each paper free to do its editorial writing. Papers are good or bad as they reflect and pander to the tastes of their readers. Associated journalism, from the breadth of its reach and diversity of readers, must have that broad sympathy and better ideals which are present in and demand expression from the masses of humanity. Associated journalism cannot, and would not, if it could, destroy the place occupied by those great leaders of opinion and moulders of thought in the world of journalism. Nor will they ever become subject to associated journalism. It bids them good speed and wishes them success in their efforts to lead people to right thinking and right living. And with them its work will be not only to express truth, but to suppress scandal, stamp out falsehood, kill sensation, and blot from existence that abominable scrutiny into private life, the present bane of the American newspaper.

LIQUID FUEL.—At a recent meeting of the Shipmasters' Society, of London, a paper was read on "Liquid Fuel in Ocean Steamers," by Captain W. V. Carmichael. The lecturer stated that, partly owing to the cheapness of coal, and partly to the reluctance of owners to adopt it, the use of oil fuel had not hitherto been much taken up by steamship owners. An economy of space was effected, since the oil could be carried in the cellular bottom of the ship. Moreover, the fires could be entirely controlled by the engineer on watch. As the consumption of oil, compared with coal, was, weight for weight, one-half—ten tons of coal, in other words, being only equal to five of oil—the storage of fuel could be made much more compact and easier of access; there was increased speed in fueling the ship; and port charges were avoided, as more fuel could be carried in proportion than formerly. Petroleum was to be found in all parts of the world, and competition would probably bring the fuel within easy reach of the commercial world. With regard to the important question of fueling our men-of-war at sea during a blockade, he thought the large tank steamers of to-day could always fuel the fleet, even in heavy weather.

"NICKEL-IN-THE-SLOT" MACHINES.

By W. L. AUGHINBAUGH.

IN the United States and in Europe within the short space of four years have been developed into practicability the now well known "nickel-in-the-slot" machines—a class of apparatus entirely unknown in either country at the beginning of that time, so far as commercial purposes were concerned, although the principle was thousands of years old. In fact, up to the beginning of 1888 only about forty patents had been issued from the United States Patent Office for such devices. So rapidly has the art been developed that up to the present time there have been issued from that office about four hundred patents, and it has been found necessary to establish a new class, entitled "Coin-controlled Apparatus," said class being divided into twenty-four sub-classes, the latter based upon lines of present and anticipated growth in various forms of the devices.

As many patents have been granted in England as in this country for the same kind of machines, while a large number have been issued in Germany.

One may now drop a coin in a slot and get therefor a cigar, cigarette, piece of candy; or have his boots blacked, or see a panoramic exhibition, a game of base ball, a horse race; or get a glass of soda, lemonade, mineral water, a cup of tea, a cup of coffee; or have a spray of perfume thrown on his handkerchief; or send a telephonic message; or enjoy an electric shock, test his lungs, ascertain his striking capacity, have his height measured, get weighed, and have the result of both the latter and the date of the occurrences printed on a card and delivered to him; or get a postal card, a postage stamp, a newspaper; or borrow an opera glass, a fan, a book; or have his age told; or set a phonograph in operation and "hear the band play;" or get his life insured, or have his picture taken; or get an "original package," or have an automaton throw dice and win (or lose) a prize. These machines are, besides, adapted for other purposes "too numerous to mention" herein.

The construction of most of the earlier machines was substantially as shown in Fig. 1. In the diagram, A is

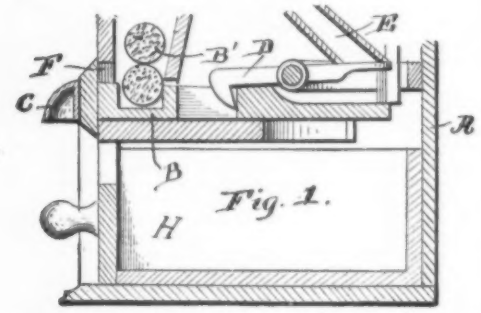


Fig. 1.

the case containing the mechanism; B, the article receptacle; B', an article; C, a handle connected to the receptacle; D, a hooked lever fulcrumed so that the hook normally rests over the edge of the article receptacle or drawer; E, a chute to guide the coin on to the outer end of the lever and tip the latter so as to release the hook from the receptacle; and F, an opening in the case of such a size as to allow but one article at a time to be delivered when the handle is drawn out. When a coin is dropped in the slot (not shown) at the outer side of the case it runs down chute, E, and tips the lever, and the purchaser draws forward the handle, C, takes out the article, and pushes back the handle and drawer; or the drawer may be retracted by a spring or weight. H is the money till.

The first patent showing anything analogous to the present coin-controlled apparatus was granted in England, being No. 8,113, of 1839. The device was intended to prevent the use of seats in public vehicles unless the fare had been prepaid, upon which payment a disk or "counter" was given the passenger. An arm normally extended over each seat so as to prevent its being used. A chute led to a lock which might be operated, to allow the removal of the obstructing arm, by dropping the disk or counter into a slot at the top of the back of the chair.

English patent No. 2,828, of 1870, was entitled a "vending machine," and was intended to be used for selling "various articles," although "bottles" are the only things specifically mentioned.

Of the forty patents granted in the United States prior to 1888 for coin-controlled machines, some were of such a character as to adapt them for public use only in localities where the people were exceptionally honest. This defect was so glaring in some of them that when, some years ago, an inventor offered his patent for sale to a large manufacturing company, the manager of the company convinced him that his machine could be "beat" in thirty-eight different ways. Of course, there was no sale.

The principle upon which many of the earlier coin-controlled apparatus were constructed is, as already intimated, at least two thousand years old, and was illustrated and described in Heron's *Spiritalia*, from which work the description and illustration were copied into Ewbank's "Hydraulics and Other Machines," published in New York in 1842. This device was employed by the priests at Alexandria, in Egypt, at the time mentioned, for selling "lustral" water to their parishioners. In Fig. 2, A is the case; B, the water tank; C, a lever, the outer end of which is a coin pan and the inner end of which is attached to a valve rod, D. E is a coin slot. Upon dropping a coin into the slot it would fall on to the pan end of the lever, depressing it and raising the valve, thus allowing the liquid to flow out. As soon as the coin rolled off the pan the valve reseated itself, and the flow was stopped until another coin was deposited. That might have worked successfully two thousand years ago. The small boy of the present day, however, would have soon run the tank dry, had it contained anything good to drink, without spending a penny.

Many of the apparatus require the aid of the would-be customer to obtain the article after the coin has been deposited, as by pushing in a lever or pulling out a drawer. Others act entirely automatically after the coin has been deposited. Some of the latter have mechanical motors to aid in their operation, while others are actuated by electrical energy.

Most of the apparatus are provided with automatic means for closing the coin slot when the last article

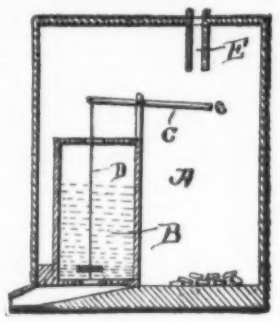


FIG. 2.

has been delivered, and also for exposing a sign to that effect, so that the money of the customer may not be lost to him.

In Fig. 3 is illustrated a typical apparatus, as shown in patent No. 387,130. A curved skeleton coin chute, *i*, leads to a lever, G, supporting a coin pan, H. The articles are piled in compartment, B, the lower one being directly in front of a projection, *d*, of a delivery slide, D, which latter is provided with a handle, E, extending in front of the frame, and having a retracting spring, d^2, at its rear end. On plate, D, is a vertical projection, J, which normally rests against the inner end of the lever, G, the latter thus preventing the

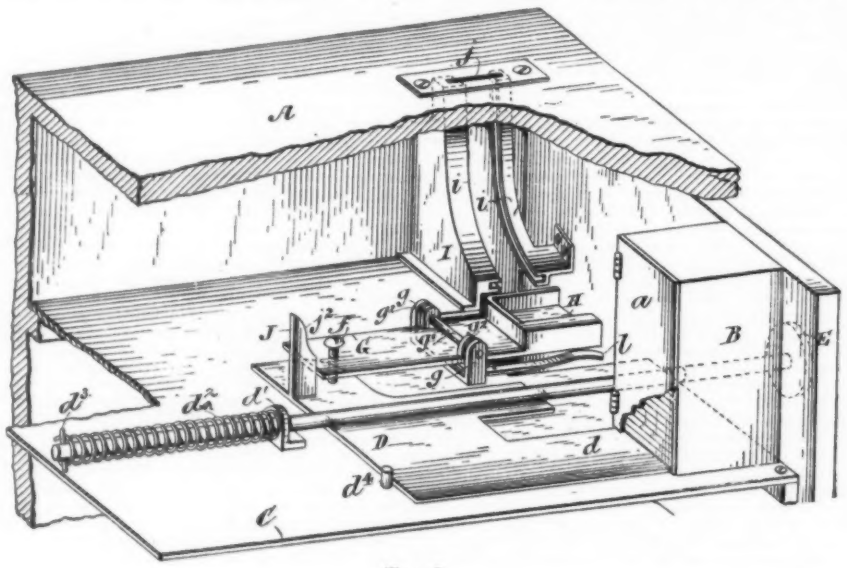


FIG. 3.

forward movement of the delivery slide. When a coin falls upon the pan, H, on the forward end of lever, G, the inner end of the lever is raised above the projection, and a pull at the handle causes the slide, D, to push out the article. A spring, *l*, under the pan, H, restores the lever to its normal position when the slide has been drawn in by spring, d^2.

The machine for which patent No. 388,369 was allowed sells newspapers and makes change—the change being preferably kept in envelopes. The coin to be exchanged—of a specific denomination—is dropped into a slot, when the change-containing envelope is fed out. The proper coin is then selected by the customer and put into a different slot leading to a pan, the depression of which pan lowers a stop sufficiently to allow one paper to slide out, the papers being folded and retained in inclined piles. This apparatus registers the number of articles sold.

There are someother patented machines by which change is made, their mechanisms being quite complicated.

The apparatus in Fig. 4 sells coffee, tea, cocoa, sherbet,

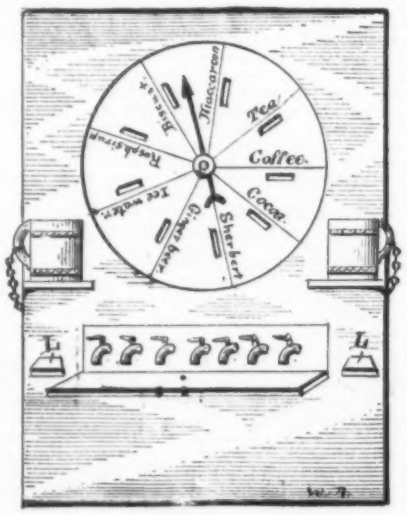


FIG. 4.

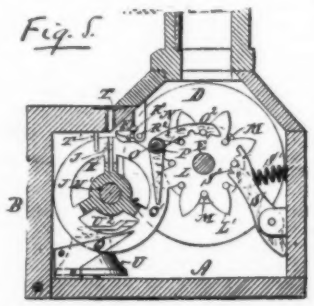
maccaroons, iced water, ginger beer, raspberry sirup, and biscuits. The liquids are kept in compartments lined with non-conducting material, and each kind of liquid is delivered from a different faucet. Cups secured by chains are kept at the sides of the case. The customer turns the pointer, D, to indicate the article desired, drops his coin in the slot adjacent to the name of the drink wanted, and it is delivered by the faucet. The biscuits are carried on an endless belt (not shown), set in operation by more complex mechanism, and are delivered on the trays shown at L. This apparatus has been patented in England and in Germany.

In patent No. 376,021, which is a newspaper selling machine, provision is made for vending papers of several different prices—say, one cent, two cent, three cent and five cent papers—there being separate coin chutes leading to distinct coin-controlled apparatus for each different newspaper. The papers are piled in compartments, each of which is covered by a flexible apron having perforations adapted to fit over pins on a wheel, which wheel is set in motion by a weight connected to the inner end of the apron. The wheel is retained from rotation by a pawl. Upon dropping the money in the slot it is guided over an end of the pawl which projects into the path of the coin, the other end of the pawl being thus raised and releasing the wheel long enough for the outer end of the apron to uncover one paper. The next pin on the wheel then enters a perforation on the apron and retains it until again released.

A German took out a patent in his own country and another in this (No. 378,982) for an apparatus which sells articles such as cigars and also liquid refreshments. As complementary to the latter part of his device, he arranges a case containing a beer mug, which latter may be borrowed by the deposition of a proper coin, which is returned to the depositor when he has restored the mug to its case.

In patent No. 381,892 (see Fig. 5), the lowermost article rests upon a rotatory delivery cylinder, D. The cylinder, D, is by pawl, N, given a step by step movement to bring the articles to be sold within reach of the customer. The pawl, N, is caused to operate by a coin dropped through a slit, T, in the case into a groove, J, in a wheel, H. In the path of the coin, as the wheel is turned, is a spring-held

Fig. 5.

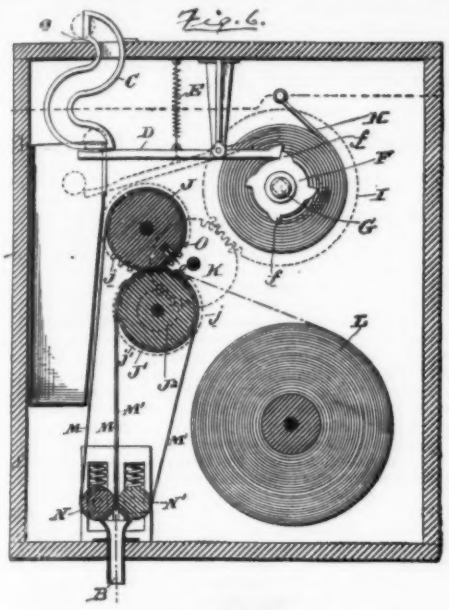


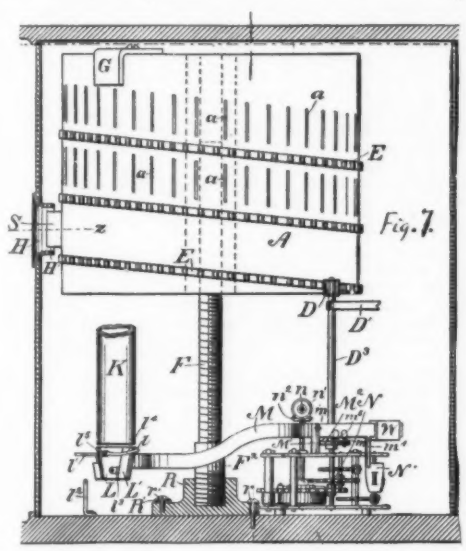
pivoted knife, R. If the coin is good, it presses the knife out of its way and operates the pawl. Should the would-be customer have substituted a lead, a wood, or a pasteboard disk, the knife would cut it and prevent the delivery of the article.

In hotels great loss has been experienced by the theft of toilet paper, as well as by the use thereof by persons who are not guests. In Fig. 6 (patent No. 417,726) is illustrated a means to prevent such loss, it being the patentee's intention that the clerks of hotels shall furnish guests with disks or checks whereby the apparatus may be operated, and that other persons may obtain the paper by dropping a penny into the slot. The paper is in a roll, L, and passes between two feed rollers, J, J', and feed belts, N, M', to the exit, B. The feed rolls have gears at their ends which mesh with a gear on a spring-operated shaft, G. This shaft is prevented rotating by detent, D, resting against one of a series of projections, *f*, on shaft, G. The feed rolls are provided with knives for cutting off a sheet of proper length. A coin falling upon the long arm of lever or detent, D, through curved chute, C, depresses that end of the lever releasing shaft, G, and the spring causes the train of gears to operate to feed out the cut-off sheet. The curved chute prevents a wire or rod being run down it to set the device in operation.

Patent No. 412,315 (see Fig. 7) shows a device for selling stamps, cards, or tickets, which are placed in slits

in cylinder, A. The cylinder has an internal nut which works on vertical screw, F. Cylinder, A, has a spirally arranged rack, E, upon it, with which engages pinion, D, which latter is driven by a suitable clockwork motor, N, set in operation by the coin falling through chute, K. As the cylinder rotates, the stamp, card, or ticket, S, is caused to project through the opening, H, in the case, whence the customer removes it. Suitable mechanism prevents further rotation of the drum





until another coin is deposited. This device is entirely automatic.

The first liquid-dispensing device was patented in 1884, in this country, No. 309,219, for the sale of soda water and similar beverages. As shown by Fig. 8, the

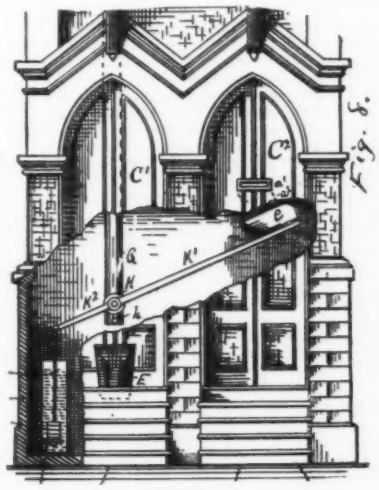
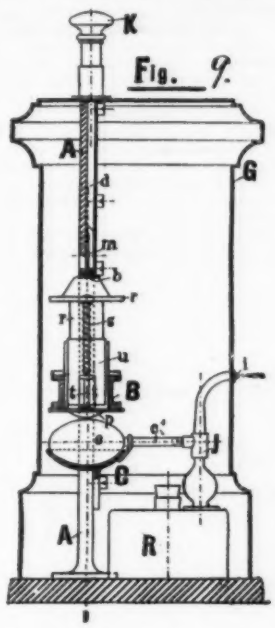


FIG. 8.

valve is operated by a coin passing through a chute and operating an arm of a lever so as to open said valve and allow the liquid to flow into glass, E. The rolling of the coin from the lever allows the valve to be reseated—the principle being quite similar to that of the Egyptian invention. There are various differences, however, which render this device novel over its ancient predecessor.

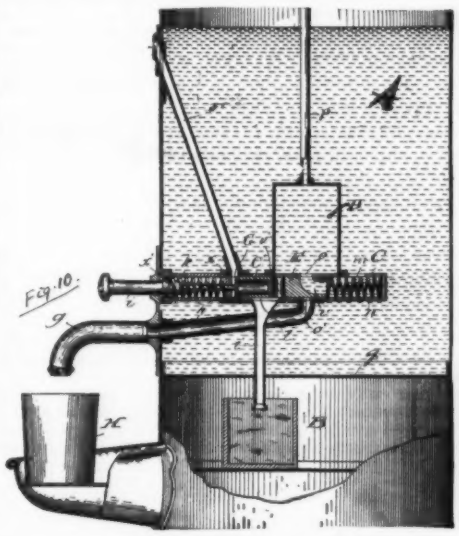
Numerous liquid sellers are for dispensing sprays of perfume, one of these machines being patent No. 417,348 (see Fig. 9). In this device the perfume is contained in a rubber receptacle, *c*, having a pipe, *c'*, leading to a spraying nozzle, *i*. The coin, *p*, is dropped into a chute which causes it (the coin) to rest on the receptacle. Directly above the receptacle is a spring-retracted plunger, K. Upon pressing down the plunger the liquid is forced in a fine spray out of the nozzle, *i*, upon the handkerchief of the purchaser. When the



plunger is released, the spring raises it and allows the coin to run into the money drawer. Other machines sell half a dozen varieties of perfumes.

Many patents have been granted for machines for selling mineral waters, ice water, lemonade, and similar drinks. In Minneapolis, the police have been given instructions to specially protect devices of this class, as in warm weather thirsty persons have their thirst allayed without patronizing saloons, by dropping a cent in the machine and thus obtaining a glass of cool mineral water brought from a popular spring.

Fig. 10 shows the internal arrangement of a device of the latter kind, patent No. 430,635. The liquid is stored in reservoir, A, the compartment, B, holding



just a glassful. Leading upwardly from B is a vent pipe, *p*. The bottom of compartment, D, opens at *o* into a tube, C. In tube, C, is a slidable valve, E, having two openings, *v*, *v'*, the first for admitting the liquid into the tube, C, and thence to receptacle, D, and the other for allowing the liquid to flow from D into tube, *h*, and thence into the glass outside the case. Before this can be accomplished, however, a coin, G, must be dropped into chute, F, which guides it (the coin) between a plunger, *i*, and a hollow piston, C'. The piston is made hollow so that the plunger will enter and not operate it (the piston) when the plunger is pushed in unless a coin has first been inserted, as shown. Upon thus forcing the plunger the openings, *o* and *v'*, are brought in line with upper end of tube, *g*, and the contents of receptacle, G, thus discharged into the glass. Upon releasing the plunger, *i*, the coin drops into tube, *l*, and thence into box, B, and spring, C, restores the piston to its place, the liquid then flowing (through tube, C, and valve, *v*) into and refilling receptacle, D. One machine provides for a preliminary discharge of liquid for rinsing out the glass before drinking.

Patents No. 405,943, 405,944, and 405,983 were granted to an Englishman for gas-vending apparatus. The mechanism of each is quite complicated, and consists of means set in motion by a coin whereby a meter is caused to operate for a length of time corresponding with the amount paid. It is not known that any of these gas-vending machines have been put in use in the United States, but they have proved quite popular in England. One penny's worth of gas may be paid for, and if that is not sufficient the user may afterward drop in another penny, and so on, paying for just the quantity desired.

Among the patents taken out there is one (414,000) in which on the dropping of a coin into the chute an electric motor is energized, which causes the operation of a miniature engine and the alternate lighting and extinguishing of two series of electric lamps. These devices are, of course, inclosed in a glass case, so that the various operations may be clearly viewed.

A base ball game is started by dropping a coin in the slot in the machine shown in patent No. 414,633. The "nine" move about very actively. The ball (tied to a string) is pitched and knocked about the field. There is never any "kicking" against the umpire's decisions in this game.

Patent No. 437,406 is entitled "voting machine and toy bank." One of its intended uses is for voting at church fairs and the like. At the front of the case are exhibited the pictures of the candidates for canes, hats, watches, etc. The coin may be dropped in the chute, and pass "by chance" into a conduit leading to the box of one of the candidates; or the coin may be dropped into a particular chute leading to the box of the favorite candidate.

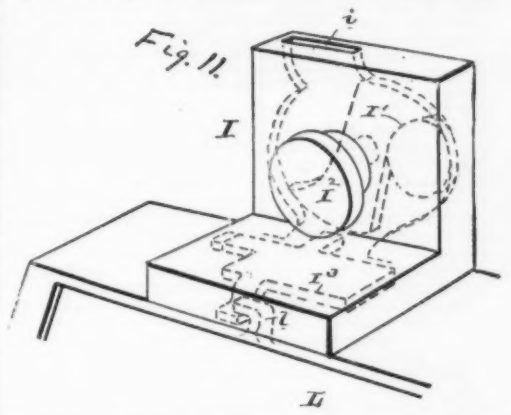
Patent No. 399,129 is a coin-controlled age-telling machine, now found in many public places. The principle upon which the age is "told" is as old, no doubt, as any person now living, but the mechanism is new.

In the patent office sub-class of "loan receptacles" are to be found not only devices to be attached to the backs of chairs in theaters for renting opera glasses, but cases for containing books to be loaned, the locks of which cases may be opened upon inserting a coin in a slot. These latter devices are intended to be exposed in public places, as depots. One of the specifications states that the patented apparatus is to be used for loaning books, magazines, etc., and that a chain or cord is to be attached to the article to be loaned.

There are shown in the same sub-class devices for attaching boxes for the sale of candies to chairs in opera houses, and the loan boxes in theaters are also described as adapted for containing other articles for rent besides opera glasses, as fans and librettos.

The first patent taken out in this country for a coin-operated opera glass holder was No. 390,623, October 2, 1888.

The box most generally used in theaters for holding opera glasses is constructed substantially as shown in Fig. 11. The glasses are held in a case having a door,



L, so arranged as to fall open, or to be thrown open by a spring, upon the coin being deposited and a lever or button operated. In this view *i* is the coin slot. Upon depositing a coin therein it is caught by an arm, I', rotated by a thumb wheel, I^2, and by the movement of arm, I', the coin is forced down between the edge of the slotted frame, I, and the rearward projection of the slidable lock, I^3, the forward edge of which catches under the hooked end, *l*, of door, L. This releases the door, L, and it drops, exposing the opera glasses.

Such glasses have been generally secured by chains to the boxes, in order to prevent the borrower becoming a thief. A chain was not a popular attachment even to honest customers. In order to overcome this objectionable feature various means have been adopted. One was to so construct the boxes as to prevent their being closed except when specially locked by attendants. The box always stood open after the glasses had been borrowed, and the borrower was expected to restore them thereto, without being able to shut the door. The attendants then hurried around at the close of the performance to see that each glass had been returned.

Two patents have also been granted for devices to notify the box office of the theater as to each glass loaned, thereby dispensing with the use of the chain, and also enabling the attendants to know the exact numbers and locations of the glasses borrowed. Each device consists, broadly, of an electric circuit which is completed by the removal of the glasses, the wires of the circuit being caused to operate an indicator in the office. About the time of the close of the entertainment the attendant at the box office operates a switch so as to ring an alarm at each loan box if the opera glasses have not been returned. The attendants in the auditorium will then have no difficulty in ascertaining which of the audience have neglected to return their borrowed glasses.

Several patents have been issued for coin-controlled apparatus whereby motors for phonographs may cause the latter to be set in operation to reproduce vocal and instrumental music, speeches, etc. The accompanying Fig. 12 (patent No. 431,883) shows one of these devices, the inclosing case being omitted. The electric motor is indistinctly shown in dotted lines at the right hand end of the view, and is intended to set the phonograph in operation upon a coin being deposited in a chute formed by levers 1 and 2. A is the phonograph and *a* the diaphragm carriage. To carriage, *a*, is secured one end of a cord, 20, to the other end of which is attached a weight, 19. The motor is so connected to the carriage, *a*, as to move the latter to the left, when it (the motor) has been energized by depositing a coin into chute, 1, 2, thus closing an electric circuit leading to the motor.

As the diaphragm moves to the left the music is reproduced. About the time the carriage arrives at the left end of the cylinder, and when the tune has ended, the weight, 19, strikes the arm, 2^a, of lever, 2, thus releasing the coin and breaking the circuit to the motor. The coin then drops into the second chute, formed by levers 9 and 10, whereby a second circuit is completed, which actuates a carriage-releasing mechanism, whereupon the weight, 19, descends and retracts the diaphragm carriage, *a*. At the lower portion of its descent

weight, 19, strikes lever, 18, thus retracting lever, 10, of the coin chute and releasing the coin, thereby breaking the second circuit and restoring the devices so as to be ready to again operate upon the introduction of another coin.

The first patent granted in this country for a coin-controlled apparatus adapted to take and deliver a photograph was No. 396,428, January 22, 1889. A patent was issued in England in 1887 for an apparatus of that kind. Up to January, 1891, nine patents had been allowed in the United States for similar apparatus. The devices are all so complicated that little idea of their operation could be obtained except by carefully reading an entire specification in connection with the drawings.

Among other peculiar patented devices are the following:

A device (patent No. 441,613) in which a coin is deposited in a slot leading to a miniature cannon in one end of a case. The depositor then aims the cannon at

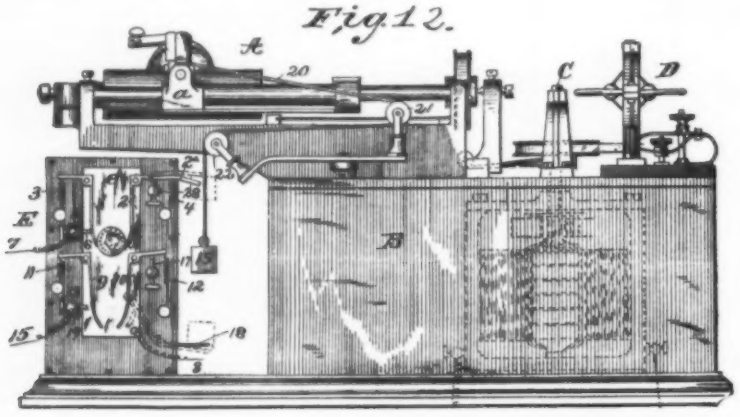


Fig. 12.

one of a series of targets arranged at the other end of the case. If the coin strikes the target, a cigar or other article is caused to be fed out of the machine to the marksman. If the target be missed, the money is lost.

A coin-operated shooting gallery has also been patented, in which the person desiring to try his skill with a pistol may, upon depositing a coin, fire several shots before the "shooter" is rendered inoperative. If successful in hitting the target, a prize is delivered.

A coin-actuated billiard marker has been patented, in which the counters are locked as they move in one direction in the game, and cannot be moved backward until a coin is deposited.

Another patent is for a toll apparatus for electric light, whereby "passengers in railway carriages and other vehicles" may obtain electric light for a given length of time by inserting a coin into the apparatus.

A tool-sharpening machine, whereby, upon depositing a coin, a sharpening stone is caused to reciprocate a sufficient number of times through an opening in a case to sharpen an ordinary tool held in contact with said stone, when the stone is withdrawn until another coin shall have been deposited.

A "message cabinet," whereby, upon depositing a coin, a communication may be written upon paper through an opening in a cabinet, and by the insertion of another coin (presumably by somebody else than the writer), the message may be viewed and read.

Several apparatus wherein opera glasses kept for loan in theaters have sight-obscuring devices, which may be removed only by the insertion of a coin.

A clothes hook designed for use in public places, so arranged that clothes may be removed therefrom only by the holder of a check corresponding to the hook.

Patent No. 431,049 was allowed for a picture exhibitor, in which, as each picture is brought to the gaze of the observer, an oral description thereof is given by a phonograph, the dropping of a coin in the chute setting the device in operation.

An English patent was taken out some years ago for a coin-controlled weighing machine, in which the weight of the party on the scales is announced orally by a phonograph.

An English patent was also granted for a vending machine, in which, upon the deposit of a good coin, an article is fed out, but when a fraudulent coin is dropped in, a photograph of the defrauder is taken.

An Englishman has taken out patents in Great Britain and in the United States (No. 423,313) whereby deposits of a certain value in coin may be received in a banking apparatus and certificates of deposit issued. The certificates are consecutively numbered, and the coins deposited are piled up in the receptacle in the order in which they are received. Should a counterfeit coin be deposited, it corresponds in number with the number of the certificate issued, and the fraudulent depositor is thus detected.

There a numerous varieties of coin-controlled testing machines patented. Two of these are for testing the pulling power of *one* finger.

Another delivers a cigar to the patron by whose striking blow is indicated a certain power.

A machine patented in England feeds a cigar out of one compartment and a match with which to light it out of another.

Numerous coin-controlled weighing machines have been patented. Besides weighing the patron, the same deposit will in some of these machines cause a tune to be played and indicate the lifting power, the strength of the lungs, and the height of the customer. Several of these weighing machines deliver a ticket, with the date and the weight and the height of the customer printed thereon.

In the patent office there is a sub-class entitled "Race Courses," each patent having been granted for an apparatus in which the dropping of coin into a chute sets in motion a series of race horses. As the winning of the race is a matter of chance, many of these machines have been used in saloons to have their customers make uncertain investments. They may, of course, be employed for purposes of innocent amusement.

FRAUDS AND FRAUD PREVENTIVES.

Were all persons as honest as they should be, any of the early coin-controlled devices would have been successes. In fact, no such devices would have been required, as goods might have been left exposed, with the prices on an adjacent placard, and customers could have helped themselves and then left the proper amount in payment. Many of the patented devices were ascertained, however, soon after they had been put in use, to be unprofitable financially for the owners, although "rich in experience." The coin receptacles were found to contain—in lieu of the desired pennies or nickels—assortments of curiosities in the shape of tin-tags, buttons of all sorts, washers, disks of lead, iron, pasteboard, and numerous other things not yet monetized that could be conceived of only by the proverbial "small boy."

Things found in the tills were not the only troubles either. It was soon ascertained by those who studied the nickel-in-the-slot machines that a rod run down the chute would tip the lever so as to release the candy or cigarette drawer, and the goods soon disappeared.

It was also noticed that a lively shaking and pulling of the plunger often released the catch, and again there was no dividend for the owner.

A cord attached to a washer or to a coin having a hole in it, in the hands of a bright juvenile, would tip the lever as readily as an honest penny, and the machine was soon "pumped" out.

It was, therefore, manifest to inventors that "something would have to be done," or else they would have to go into bankruptcy. And they have now so perfected these apparatus that there is little fear of the ordinary "beats" defrauding them.

The rod or wire trick was easily defeated by constructing a zigzag chute for the coin to pass through, thus:

A nickel runs down all right, but a rod cannot reach to the bottom.

Another way to prevent the rod swindle is that shown in patent No. 407,039 (Fig. 13). A star wheel, C, is arranged in the chute, A, so that a coin may pass between the arms thereof and move the wheel so as to

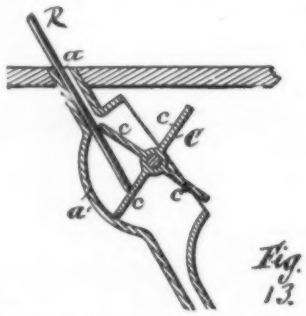


Fig. 13.

drop it (the coin) below. A rod or wire, R, inserted in the chute strikes against one arm, *c*, of the wheel, and brings another arm to bear against it (the rod), and it is thus prevented going down the chute.

The string trick was soon stopped by pivoting one or more knifes in the chutes. The coin or disk at the end of the string might tip the lever once, but on attempting to withdraw the string the knife cut it.

The use of coins or disks too small was prevented by constructing irregular skeleton chutes with guides like these [ ] for the edges only of the coins. A disk too small would fall through the chute before reaching the mechanism to be operated.

The washer trick was beaten by placing a hook so as to project into a skeleton chute. The hole in the washer caught over the hook.

Many disks, as buttons and other things, were of the right size to operate the catches and would not be thrown out by a skeleton chute. In order to stop this fraud, balanced levers were provided which could be operated only by a coin having the exact weight and dimensions.

Disks made of the exact size and weight, but of base metals, were often used to defraud the apparatus. Such disks are literally "picked up" by magnets placed either at the mouth of the coin slot or in some part of the chute.

There have been still other ingenious ways invented of "beating" the machines. It seems, however, that the *honest* inventors have exercised more ingenuity in devising ways and means to "beat" the "beaters." It may, therefore, be said that coin-controlled apparatus have already reached a point at which they may be considered commercial successes. No doubt new means may be devised to swindle their owners, but it is fair to suppose that as each new fraud is discovered, new means will be invented to defeat it.

SOME RECENT WARSHIP DESIGNS FOR THE AMERICAN NAVY.*

By J. H. BILES.

THE author commenced by saying that, having been asked by the council of the Institution to give a paper this year, he found some difficulty in choosing a subject which would be sufficiently interesting to the members of the Institution, and with which he was himself sufficiently intimate to be able to contribute anything of value. Having occasion, at the beginning of this year, to visit the United States, he had the pleasure of making the acquaintance at Washington of Mr. Secretary Tracy, of the American Navy, and the principal members of the Bureaus of Construction and Engineering. Mr. Tracy very kindly gave him the fullest information of what the Navy Department has done, is doing, and is contemplating doing, and he was very much surprised to find the designing and building of vessels for the navy in such a well organized condition. It then occurred to him that there might be many others who would be equally as surprised as he had been, and would be equally well pleased, to know what was being done by the Americans in war shipbuilding.

He told Mr. Tracy that he, Mr. Biles, had been asked by the council to read a paper this year, and he should like to give the members of this Institution some of the facts which he had been kind enough to give him. He readily consented, stipulating only one condition, that he courted the fullest criticism.

No doubt the members of this Institution were in a general way familiar with the changes that have been made during the last few years in the constitution of the American Navy, but he might be pardoned for calling the facts to their minds in a short summary. The keel of the first modern American warship was laid in 1883. The vessels then commenced were the Chicago, Boston, Atlanta, and Dolphin.

The Chicago is a vessel 315 feet by 48 feet by 19 feet draught, with a displacement of 4 500 tons, and with machinery of 5,000 indicated horse-power and a speed of 15½ knots. The Chicago's coal supply is 940 tons, and she carries four 8 inch, eight 6 inch, two 5 inch, and twelve small rapid-firing guns. The 8 inch guns are central pivoted, carried on four sponsons on the upper deck, two forward and two aft. Shelter decks or screens are formed over each pair of guns, and they serve as bridges. The 6 inch and 5 inch guns are all worked on the main deck, the 5 inch being aft. They are all mounted on the old-fashioned slides. It may be interesting to compare this vessel with the Arethusa, of approximately the same size, built about the same time for our own navy. The Atlanta and Boston are sister vessels, of a smaller type of dimensions—270 feet by 42 feet by 17 feet draught, with a displacement of 3,189 tons, indicated horse-power about 3,500 and a speed of 15½ knots. The Atlanta and Boston's coal supply is 400 tons, and they have each two 8 inch, six 6 inch, and twelve small rapid-firing guns. The 8 inch guns are mounted one forward and one aft, firing round the bow and stern, thus making the freeboard at the extremities very low. The 6 inch guns are carried on the same deck, but under a shelter deck. The Dolphin is a vessel 240 feet by 32 feet by 14¼ feet draught, with a displacement of 1,485 tons, and 2,240 indicated horse-power and a speed of 15½ knots. She is a dispatch vessel, with a small armament. The Arethusa is 4,300 tons displacement, carries ten 6 inch and eighteen small rapid-firing guns. Her hull protection is similar to the Chicago's, and her coal supply is about the same, but her speed is about a knot and a half more.

It was not till 1887 that any more warships were laid down in America, when the Newark, Charleston, Baltimore, Philadelphia, San Francisco, Yorktown, Concord, and Bennington were commenced.

It will be seen that the progress made in America is great, if we measure it by the difference between the Chicago and the Baltimore. These vessels are of practically the same displacement, though the Baltimore has a smaller main battery, having only ten guns, against fourteen of the Chicago's, but her speed is more than three knots greater than the Chicago's, and she has a protective deck 2½ in. thick on the flat and 4 in. on the slope. The Philadelphia, which is a sister ship to the Baltimore, attained a still higher speed; and the San Francisco, which is a little over 4,000 tons displacement, attained a speed of over twenty knots. The Newark, a sister ship of the San Francisco, has attained a speed of 20·4 knots. These trials are made at load draught, under forced draught, and the speed is a mean of four hours' run, two with and two against the tides, the speed of the tide being carefully measured at several points on the route by boats stationed for that purpose. We have no vessel in the British Navy which can be closely compared with these, as during the period between 1883 and 1887 the cruisers built in this country were either belted, and therefore larger and more costly for the same fighting power, or if of the same type, smaller and slower. The four 8 in. guns in the Baltimore are carried two on the forecastle and two on the poop, on sponsons, and the six 6 in. guns are carried on sponsons on the upper deck. In the Philadelphia, however, all the guns are 6 in., four of them being carried on the poop and forecastle, and eight on the upper deck in the waist of the ship. Four of these latter are covered by wide platforms, which afford shelter to the men at the guns and form bridges. The Newark and San Francisco are slightly smaller than the Philadelphia, but they have the same arrangement of armament. The Charleston is 3 ft. less beam and 1 ft. more draught than the Newark. The Baltimore, Philadelphia, and Charleston are

* From a paper read before the Institution of Naval Architects, London.

from designs supplied by Mr. White, but the Newark and San Francisco are American designs. The Navy Estimates of this year, recently published, give some particulars of eight vessels of 4,360 tons displacement about to be built, having forced draught speed of 19¼ knots and a coal supply of 400 tons, with an armament of two 6 in., eight 4·7 in., and nine small guns. These vessels are 320 ft. by 49 ft. 6 in., and seem to be very similar in dimensions and speed to the American ships. The Baltimore has, since her trials, been on a long cruise, and has shown herself to be a good sea vessel. She steamed from New York to Stockholm at a speed of about 11 knots without stopping to coal, and I was assured by her captain that she could have steamed 1,500 knots further at the same speed with the coal that she actually carried. She steamed from Copenhagen to Lisbon in five days three hours, the distance being 2,100 knots, the last two days being done at reduced speed in order to save coal. This gives a mean speed of over 17 knots. The ventilation of this vessel is reported as excellent, and, judging from the number of ventilating cowls on her, it should be; but these cowls add very considerably to her visibility, and make her a much better target for an enemy than she would be without them. The American ship designers and builders have shown that they are capable of producing vessels quite equal to their promises, and at least equal to the best European practice. This is an important thing to bear in mind in considering the recent designs upon which ships are now being built for the American Navy. It was not until the end of 1889 that any considerable further additions were arranged for, but there are now under construction seven cruisers and seven armored ships.

Texas, Maine, Monterey, New York, coast line battle ships Indiana, Massachusetts, and Oregon, cruisers Nos. 6, 7, 8, 9, 10, 11, 12, and a harbor defense ram. The Texas is called a "battle ship." She has two turrets, each carrying a 12 in. gun, protected by 12 in. of armor. The turrets are placed *en echelon*, the bases being protected by a redoubt of 12 in. armor passing round both turrets, and extending to the main deck. She has a partial belt 6½ ft. wide extending about two-fifths along the side of the ship, the remainder of the length being protected by a deck 2 in. thick on the flat, and 3 in. on the slope. In addition to her 12 in. guns, she has six 6 in. and twenty-two small rapid-firing guns. Two of the 6 in. guns are worked on the upper deck and four others on the main deck. Her machinery is 8,600 indicated horse power, and speed expected seventeen knots.

The Maine is called an "armored cruiser." She has two turrets, each with two 10 in. guns, each protected by 12 in. armor, the bases of the turrets being protected by separate redoubts of 12 in. armor. Her side is protected by 12 in. armor belt, extending nearly half the length of the ship, the ends being protected in a similar manner to the Texas. In addition to the 10 in. guns in the turrets, she has six 6 in. and twenty-two small rapid-firing guns. Two of the 6 in. are under the forecastle, and fire right ahead. Two are under the poop, and fire right astern. The remaining two are in the center house, above the level of the other guns. Her engines are 9,000 indicated horse power, and the speed expected seventeen knots. This vessel is in many respects like the Brazilian armorclads Riachuelo and Aquidaban, but with a greater speed, more powerful armament and protection. The radius of action of both the Maine and Texas at ten knots is 7,000 knots.

The Monterey is practically a low freeboard monitor. She has two 12 in. guns in a barbette forward, and two 10 in. guns in a barbette aft. The forward barbette has armor 14 in. thick, the after one 11½ in. thick. The guns have 8 in. sloping shields over them. She has a complete belt of armor 4 ft. 6 in. wide, 13 in. thick, and a complete protected deck 3 in. thick. The armored freeboard amidships is 2½ ft. In addition to the heavy guns, she has twelve small rapid-firing guns. The horse power of the engines is 5,400, and the speed expected sixteen knots.

The New York is rated by the Americans as an "armored cruiser." She is of a type somewhat between our first class cruisers of the Edgar class and the Blake and Blenheim, being practically the same length and breadth as the latter. Her arrangements of machinery are similar to the Blake's, having four sets of triple expansion engines. She has a protective deck running the whole length, extending from 4 ft. 9 in. below the water at the side to a foot above the water amidships, 6 in. thick on the slope, and 3 in. thick on the flat, reduced to 2½ in. at the ends of the vessel. In addition to this she has a belt of 5 in. armor in wake of the machinery spaces between the protective and main decks. Behind this belt is a cellular space 3½ ft. thick, filled with water-excluding material, extending the full breadth of this belt. This cellular structure is carried the whole length of the ship. The armament consists of six 8 in. guns, two mounted in a 10 in. barbette forward, and two in a similar barbette aft, and one on each broadside amidships on the upper deck.

The revolving shields on the guns are 7 in. thick. She has twelve 4 in. rapid-firing guns and sixteen smaller rapid-firing guns. She has four torpedo tubes, one in the bow, one in the stern, and one on each broadside; those on the broadside train. The height of the centers of the guns of this vessel is considerable, the 8 in. being 25 ft. above the water, and the 4 in. 16½ ft. The estimated radius of action of this vessel at 10 knots is 13,000 knots. The engines are 16,500 indicated horse power, and the estimated speed is 20 knots. Her sustained sea speed is 18½ knots. Draught, 23·3 ft. She has electric light, and fan ventilation throughout. Compared with the Edgar class, this vessel is much more powerfully armed, and much better protected. Her sustained sea speed will probably be greater. She is, however, 800 tons more displacement, and should therefore be a superior vessel. Mr. Secretary Tracy thinks that "four such ships distributed in various quarters would put an effectual stop to the depredations of as many fleets of ordinary cruisers." The coast line battle ships are the most important vessels of this programme. They are three in number, two of them to be built by Messrs. Cramp, of Philadelphia, and the third at the Union Ironworks, San Francisco; these vessels have a displacement of 10,298 tons. They have been designed, to use the words of Mr. Theodore Wilson, the Chief Constructor of the United States Navy, "to be able to fight vessels carrying the heaviest guns and armor," and by inference comparison with our most recent battleships cannot fail to be courted.

TABLE R.

	No. 2. New York.	No. 6.	Nos. 7 and 8	Nos. 9, 10, and 11	No. 12.	Coast Line Battleships, 1, 2, and 3.	Maine.	Blenheim.
Heating surface	31,100	28,300	16,180	11,620	43,272	17,460	18,798	33,000 (?)
Heating surface / 3	10,366	9,433	5,393	3,873	14,424	5,820	6,266	11,000
Speed due to I. H. P. = Heating surface / 3	18¼ knots.	18¾ knots.	17¾ knots.	16¼ knots.	20¾ knots.	18 knots.	16 knots.	19 knots.

The under-water protective decks at the ends of the belt are 3 in. thick; the armored deck over the belt is 2¾ in. thick. Above the 18 in. belt there is a 5 in. belt similar to our latest battle ships. The armament consists of four 13 in. 35 caliber guns, mounted in two turrets formed with inclined armor 17 in. thick, the horizontal thickness being 20 in. The bases of the turrets are protected by redoubts 17 in. thick, extending from the top of the armor belt to 3½ ft. above the main deck. These guns can be loaded in any position. In addition to these there are eight 8 in. guns, mounted in four turrets. These turrets are formed of inclined armor, 8½ in. to 6 in. thick, which is equivalent to from 10 in. to 7 in. horizontally. These turrets are placed on a deck above the level of the 13 in. guns. There are also four 6 in. guns, protected by 5 in. of armor, having 2 in. splinter bulkhead worked round the deck, the ammunition being served up inside these bulkheads. There are twenty-eight small rapid-firing guns, and six torpedo tubes. The conning tower is 10 in. thick. The 13 in. guns are 17 ft. 8 in. above the water, and 6 ft. above the deck, over which they fire. The 8 in. guns are 24 ft. 9 in. above the water, and the 6 in. guns, 14 ft. 10 in. The 8 in. guns can fire over the tops of the 13 in., and for considerable angles across the middle line of the ship. With such a large armament, the question of the supply of ammunition is a most important one, and seems to have been very well worked out. Each gun has its own magazine almost directly underneath it, below the belt deck, and therefore protected by thick armor, so that there are no ready use magazines in comparatively unprotected positions. The engines are 9,000 horse power, and a maximum speed of 16¼ knots is expected, and a sustained sea speed of 15 knots. The coal bunkers will stow 1,800 tons of coal. The estimated radius of action at 10 knots with this supply of coal is 16,000 miles. The normal supply of coal is 400 tons.

The armament of these vessels seems to be more powerful than that of any European battle ship, having four guns capable of piercing any armor afloat, and eight 8 in. guns capable of penetrating almost any armor, and certainly of penetrating the armor at the ends of the belts and on the barbettes and redoubts of most of our battle ships at close quarters. Of course, in order to attain this result, something has had to be sacrificed; or rather, something is not existent in these ships which exists in the larger ones. The speed estimated, compared with our latest battle ships, is probably about 1¼ knots less. The coal supply is 500 tons less. The breadth of the armor belt is 1 ft. less, but it is as wide as that of the Admiral class, which have not the advantage of the 5 in. belt above.

No. 6 is a vessel of 5,500 tons displacement. She is of the internally-protected type, indicated horse power is 13,500, and expected speed of 20 knots on trial, with a sustained sea speed of 19 knots. The protective deck is 2 in. thick on the flat and 4½ in. thick on the slopes amidships; 3 in. on the slopes fore and aft. She has a cellular structure 2 ft. 9 in. thick, filled with water-excluding material, extending from the protective deck at side to 4 ft. above the water line, but she has no side protection.

She has four 8 in. guns mounted in two barbettes 4 in. thick; ten 5 in. rapid-firing guns mounted in a superstructure and protected by 4 in. shields. They are so arranged that four can fire right ahead, and four can fire right astern, and five on either beam. The nearest vessels of our navy to this are the belted cruisers, which have armament inferior by two 8 in. guns, and a speed of a knot an hour less.

Vessels Nos. 7 and 8 are sister ships of 3,183 tons displacement, carrying one 6 in. and ten rapid-firing 4 in. guns. They have a protective deck 1 in. thick on the flat and 2½ in. thick on the slope amidships, 2 in. thick on the slope in the ends. A cellular structure is fitted 30 in. wide, extending from 4 ft. above the water line to the protective deck, and filled with water-excluding material.

The engines are 10,100 indicated horse power. A speed of 19 knots is expected. Cruisers Nos. 9, 10, and 11 are of 2,000 tons displacement. They have a deck similar in form to a protective deck, but it is only called a water-tight deck, being about ½ in. thick, and it extends from 4 in. above the water line to 3 ft. below. They have not the cellular structure common to the other cruisers at the water line, but have a line of cofferdams inside the bunker bulkhead, similar to the smaller vessels of our navy. They have two 6 in. guns, one on the forecastle, and one on the poop, and eight rapid-firing 4 in. guns, and ten small rapid-firing guns working on the main deck. The horse power of the engines is 5,400, and the speed expected seventeen knots. None of the cruisers, No. 6 to 11 inclusive, have any points of special interest, being similar in detail to those already described. No. 12 cruiser is, however, the most important of the cruisers. She is called a "Commerce Destroyer," and is popularly known as the Pirate. She is intended to have a sustained sea speed of twenty-one knots.

Mr. Secretary Tracy thinks this "vessel absolutely without parallel among the war ships of the world. The combination there made unites a sufficient armament with complete protection against light guns, while at the same time the vessel will have a sea speed and a coal endurance hitherto unknown in ships of war. No merchant vessel that she meets, armed or unarmed, can escape from her." She is a triple screw ship, having three sets of triple expansion engines. These engines are intended to maintain in ordinary working for long periods an average of 20,000 horse power. She has coal capacity for 2,000 tons of coal. On her normal draught she will carry 750 tons. This vessel has a protective deck 2½ in. thick on the flat and 4 in. on the slope, extending to 4½ ft. below the water line at the side, and to a foot above at the center. The battery is comparatively a light one, being four 6 in. guns and eight 4 in. rapid-firing, and about eighteen machine guns and six torpedo tubes. A cellular structure 5 ft. wide will be worked next the ship's side the whole length of the vessel. In the way of the bunkers this will be filled with patent fuel, thus forming a thick protection against machine gun fire. Forward and aft of the bunkers this structure will be filled with some water-excluding material. In the way of the 4 in. guns there will be 4 in. steel protection, and in the way of the machine guns there will be 2 in. steel. It is estimated that the radius of action at 10 knots with bunkers full will be 26,000 knots. This vessel is well divided, and would give a good account of herself against most cruisers; but she is designed to run away from cruisers, and not to fight them, her function being to catch and destroy all the merchant steamers of an enemy that she possibly can. She would not hesitate to fight and try to destroy any of our merchant ships fitted as armed cruisers. This vessel is about the same length as the 17 and 18 knot merchant mail steamers, and no doubt could very easily overhaul any vessel of her own length in almost any weather; but even though she may have a sustained sea speed in moderate weather of 21 knots, it is very doubtful whether in average Atlantic weather she could catch such vessels as the Teutonic and City of Paris, for their extra length of considerably over 100 ft., and their extra weight, which would be nearly double, would inevitably tell in a sea-way. It is further doubtful whether the bow of this vessel above water is either in shape or height well adapted for driving against a head sea at such a high speed. Her freeboard forward is 19½ ft., which is low compared to the City of Paris, which has 32 ft. This could readily be increased without seriously interfering with her efficiency in other ways. It is not very apparent what is gained by having a long projecting under-water stem in such a vessel. To use it would be to cripple herself in the quality which everything has been sacrificed for, namely, speed. A straight stem, like most merchant ships have, but with considerable flare out, would probably improve her speed in a head sea, and would certainly keep her drier forward.

The reason alleged for adopting three screws is that the vessel can be driven at less power with the center screw alone at the lower speeds than with two screws, or than with one screw in a twin-screw ship, where propulsion would have to be balanced by the rudder. This is undoubtedly true for low speeds, but a preferable arrangement could be made by having two engines on the middle screw instead of one. It may be interesting to record here an actual fact in connection with running a twin screw ship with one screw only. The City of New York ran about half way across the Atlantic with two screws, averaging 18·5 knots for eighty revolutions of both screws. An accident then happened which disabled one engine, and necessitated disconnecting the screw and shaft from the engine. She then ran the remainder of the voyage with one engine only, the other screw running loose. At eighty revolutions she maintained a speed of 16·3 knots, with three degrees of helm. The power necessary to drive the ship when running at 16·3 knots with two screws in ordinary work, compared with the crippled condition stated above, is actually more. The question of sustained sea speed is probably best determined by estimating the power that would be obtained in ordinary merchant steamer practice in ordinary sea-going work from the heating surface of the boiler. On the assumption that each indicated horse power requires three square feet of heating surface, which is average merchant ship practice, we get indicated horse powers as above for the recent American designs. The speed which would be attained in ordinary smooth water on the measured mile with these powers is also given, and this gives approximately the sustained sea speed. The sea speed expected by the American authorities is also given. Some of the later British ships' sustained sea speed estimated in the same manner is also given.

The building of such a ship as No. 12, which we have nothing to cope with, certainly is an indication of what America is capable of, both in conception and construction. Whether vessels specially designed to meet this one, or whether an improved type of mail steamers is the right protection, is a question worth some consideration. The most suitable for fighting of our armed cruisers would be very weak in presence of such a foe, but with protection as indicated above, and equal speeds, there should be little fear of a contest. There are several other very interesting vessels built, or intended to be built, for the American navy. One is a torpedo cruiser of 750 tons displacement and 23 knots speed. She is to have quadruple expansion engines of 6,000 indicated horse power and tubulous boilers. Her framing is almost completely longitudinal, and many ingenious contrivances are introduced. Another is a harbor defense ram, 243 ft. by 43·5 ft. by 15 ft. draught. This vessel has practically no superstructure, as our Polyphemus has, and carries neither guns nor torpedoes. She is, in fact, an automobile floating projectile of 2,050 tons weight. The speed is expected to be 17 knots. She has 6 in. of armor protection in the side. She has been designed by Rear-Admiral Ammen. The Cushing, recently completed, is a torpedo boat, and has attained a speed of 23 knots. She has three torpedo tubes. Her dimensions are 138 ft. 7 in. by 14 ft. 10 in. She has quadruple expansion engines. She is the only torpedo boat in the American navy. The Vesuvius, a 21 knot vessel, of 725 tons displacement, and carrying three dynamite guns, is an instance of the boldness of some of the American designers.

REMOVAL OF EARTH BY MEANS OF SCRAPERS.

IN the United States the plow and scraper are much used for the removal of earth in building railroads, laying out streets, etc. Unless the earth is very soft it has to be loosened up before it can be removed by scrapers, and for this purpose plows weighing from 100 lb. to 300 lb. are used—according to the condition of the ground—which are drawn by the required number of horses. The hardest ground or even well-preserved old macadam roads can be broken up in this way at an expense of two-fifths to one-third less than the cost of the same work done with shovel and pick.

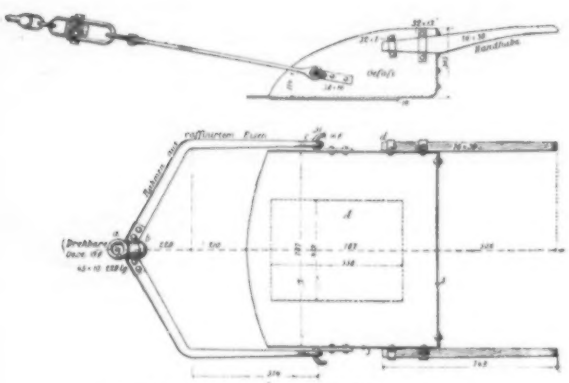
There are three different kinds of scrapers, viz., the drag scraper, the wheel scraper and the wagon scraper. The drag scraper is the oldest form, and the first ones were made of wood bound with iron, as they still make shovels in some parts of Germany. Later they were made of one piece of iron which was cut out so that the end and sides could be bent up and riveted together, as shown in Figs. 1 and 2. Now these scrapers are generally made of soft steel plates pressed into proper shape, thus avoiding all rivets, sharp corners, and flanges, on which dust and rust will collect. This newer construction is shown in Figs. 3 and 4. Friction soon wears the bottoms of these drag scrapers, so they are sometimes protected by extra plates or by two runners riveted to the scoop (see Figs. 4 and 5). But these plates add greatly to the weight of the scoops, and the heads of the rivets, although sunken, soon wear off, allowing the plates to become loose; and therefore scoops without the extra plates are generally preferred. When used on gravelly earth or sharp sand the bottoms last from eight to nine months, and with light earth, twice or three times as long.

The earth is loaded on the scraper and carried off in the manner shown in Fig. 6, except that usually the driver gives all his attention to the horses, while another man, "the scraper holder," attends to the loading. As soon as one scraper is full he leaves it to be dragged off to the dumping ground and turns to the next following scraper, which is filled in the same way. Thus, one "scraper holder" can attend to several scrapers. When a full scraper reaches the proper place the driver takes hold of the handles, raising them slightly, so that the front edge of the scoop catches in the ground and, as the horses continue to move forward, the scoop is overturned. After it has been emptied the driver takes hold of the handles again and turns it back to its normal position.

Figs. 10, 11, 12 and 13 illustrate methods of operating with scrapers. Fig. 13 shows the method followed in building a railroad embankment from cuts on each side. The embankment is built in layers about 18 in. thick, the earth taken from either cut being used only on that half the embankment lying nearest the cut in question. The dotted lines indicate the paths followed by the teams.

Figs. 10, 11, 12 illustrate the method employed in loading wagons, cars, etc. The cut through which the wagons pass in going under the loading bridge is made by means of plows and wheel or drag scrapers. The dotted circle indicates the path followed by the scrapers. Sometimes, instead of making a cut for the wagons which are to be loaded, a trestle is built on each end of the bridge, over which the loaded scrapers are dragged to dump their contents into the wagons through the funnel formed in the middle of the bridge. These trestles usually form a solid structure with the bridge, and can be moved from place to place as may be necessary. The surfaces left by the scrapers are without ridges, hollows, or steep and dangerous inclines, for the layer removed is always as thick as the furrows are deep, and this layer is taken from an extensive area of ground. The same can be said of the dumping ground.

Many attempts have been made to find a device for automatically closing the front of the scoop. The plate used for this purpose is always so connected with the scoop that it is raised when the scraper is unloaded and is held in this position by a catch. After the scraper is loaded again it can be released and sent back to its locking position. This device, which is shown in Figs. 7, 8, and 9, has never passed beyond the experi-



FIGS. 1 AND 2.—RIVETED SCRAPER.

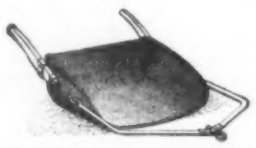


FIG. 3.—SCRAPER PRESSED FROM PLATE OF STEEL.

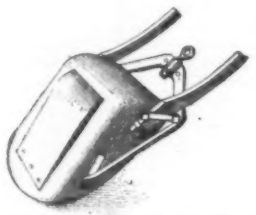


FIG. 4.—SCRAPER WITH EXTRA BOTTOM PLATE.

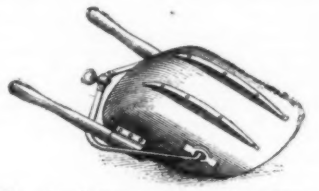


FIG. 5.—SCRAPER WITH RUNNERS

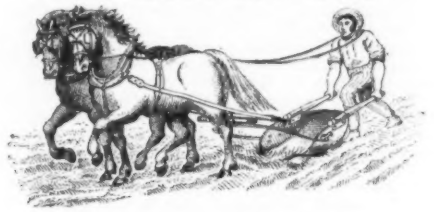


FIG. 6.—LOADING THE SCRAPER

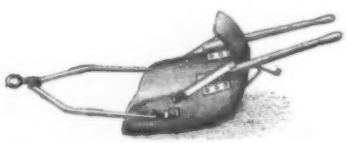


FIG. 7.—SCRAPER IN POSITION FOR LOADING.

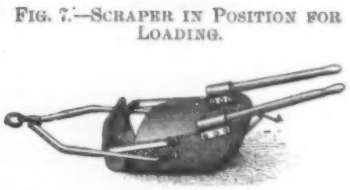


FIG. 8.—SCRAPER WITH CLOSING PLATE IN POSITION.

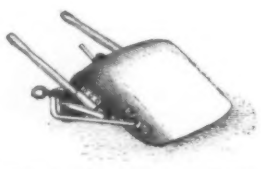


FIG. 9.—SCRAPER IN POSITION FOR UNLOADING.

FIG. 12.—CROSS SECTION, ILLUSTRATING METHOD.

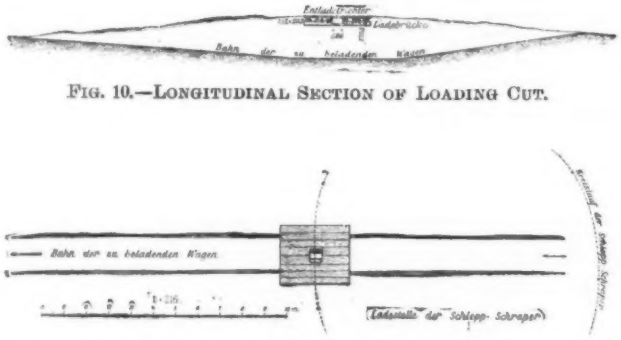


FIG. 11.—PLAN VIEW, SHOWING METHOD OF LOADING WAGONS, ETC.

FIG. 10.—LONGITUDINAL SECTION OF LOADING CUT.

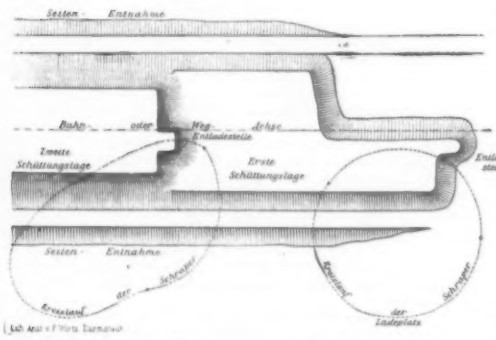


FIG 13.—PLAN OF EMBANKMENT BUILT FROM SIDE CUTS.

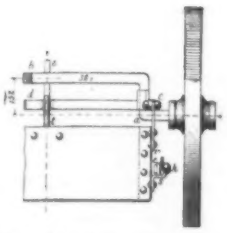


FIG. 14.—CROSS SECTION OF WHEEL SCRAPER.

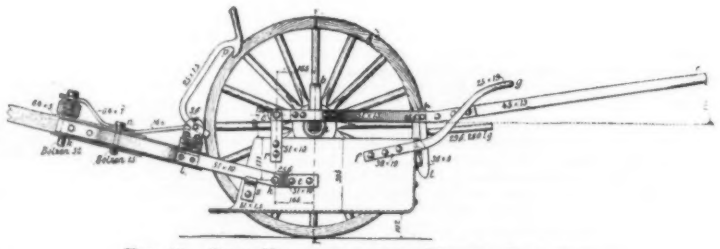


FIG. 15.—SIDE VIEW WITH ONE WHEEL REMOVED

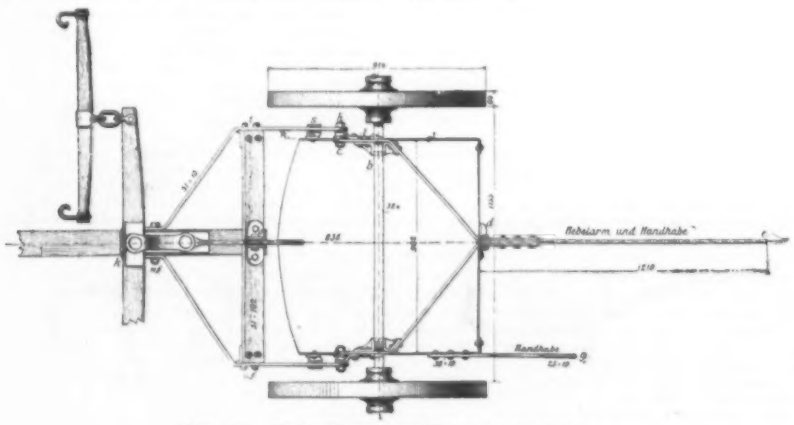


FIG. 16.—PLAN VIEW OF WHEEL SCRAPER.

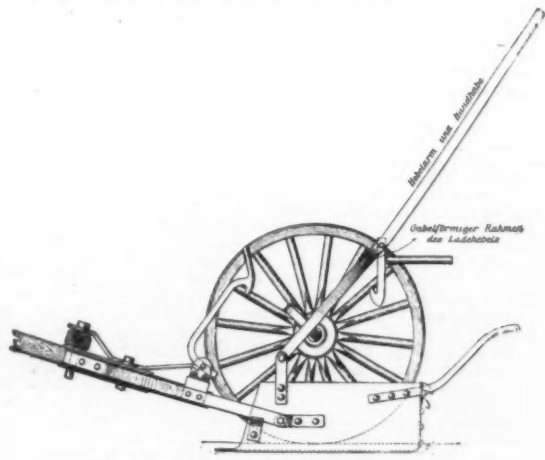


FIG. 17.—SCRAPER DURING LOADING.

REMOVAL OF EARTH BY MEANS OF SCRAPERS.

mental stage, and, considering the short distance traveled by the loaded scraper and small amount of earth lost, such a device seems scarcely desirable.

The wheel scaper has developed naturally during the last twenty years from the drag scraper. The great friction caused by dragging the latter prevented any increase in the size of the scoop, thus limiting the amount of work done by it; and therefore the scoop was hung on an axle carried by the two wheels so that it could be lowered and dragged while being loaded. Figs. 14 to 31 show devices for raising and lowering the scoops, which latter may vary in size. One of the simplest forms of scrapers is that shown in Figs. 14 to 17. During transportation the scoop is supported at three points, two of which are bolts in the short ends of a forked lever, two perpendicular hangers being mounted to turn on these bolts and extending on the outside of the scoop to which they are riveted. To prevent backward movement of the scoop, as its center of gravity lies back of these points of support, it is also supported by a hook-shaped hanger connected with the long arm of the lever by a bolt on which it turns. This two-armed lever is, in turn, supported by the axle. The center of gravity of the scoop and lever lies back of the axle, and to prevent their falling backward a lug is riveted to the front part of the scoop near the bottom flange, which rests against the drawbar.

When in the position shown in Fig. 15, if the long arm of the lever is raised, the forward flange of the scoop engages the ground and the forward pull exerted

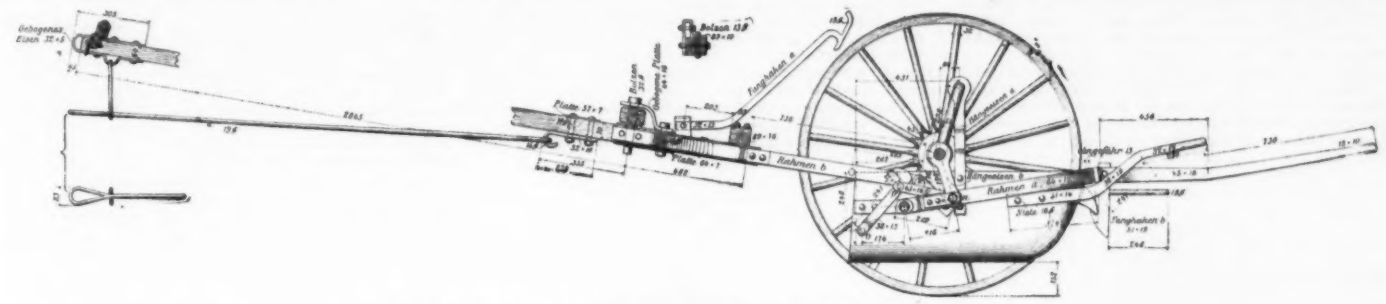


FIG. 18.—SIDE VIEW OF SCRAPER WITH ONE WHEEL REMOVED.

FIG. 19.—DETAIL VIEW.

FIG. 22.—DETAIL VIEW SHOWING FASTENING OF DRAW BAR TO SCOOP.

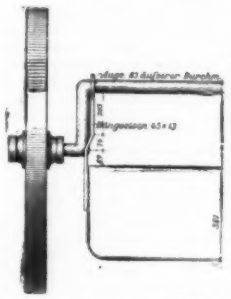


FIG. 20.—DETAIL VIEW.

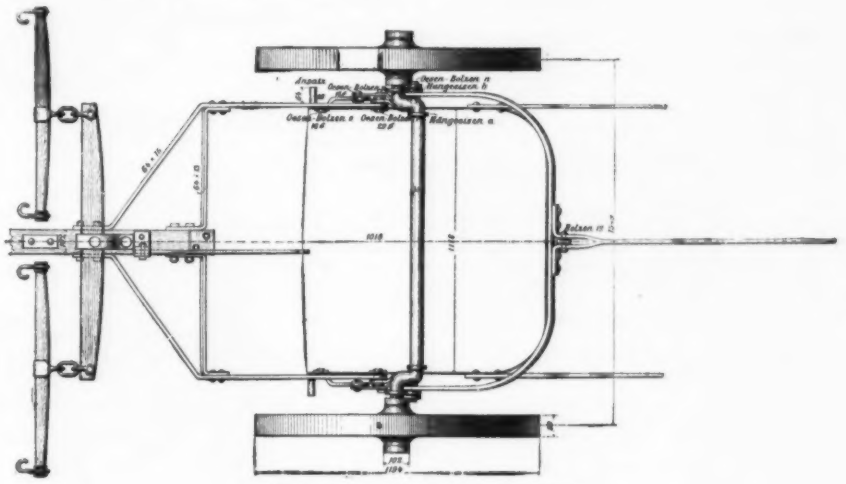


FIG. 21.—PLAN VIEW OF SCRAPER.

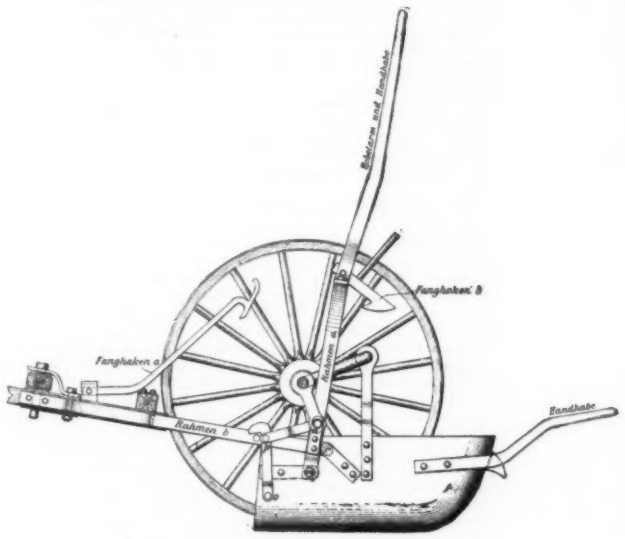


FIG. 23.—SCRAPER DURING LOADING.

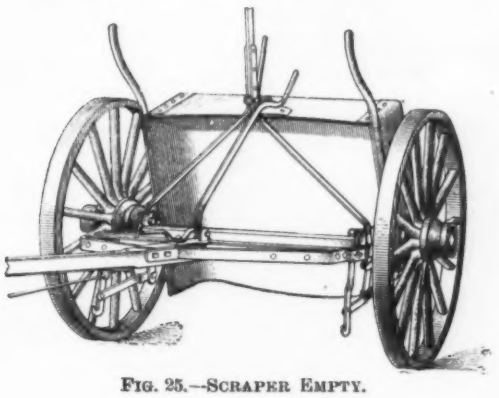


FIG. 25.—SCRAPER EMPTY.

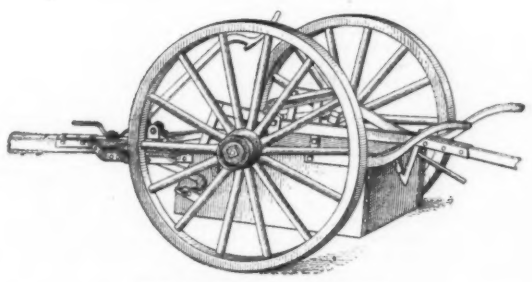


FIG. 24.—SCRAPER LOADED.

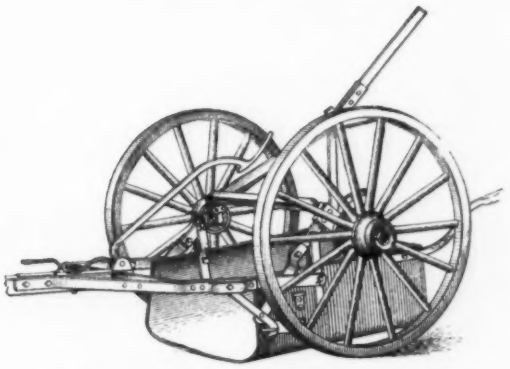


FIG. 26.—SCRAPER IN POSITION FOR LOADING.

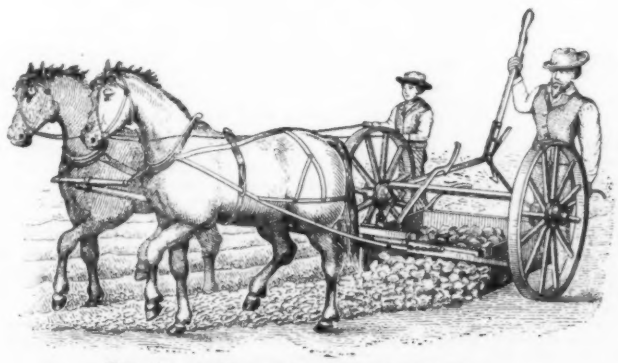


FIG. 27.—A WHEEL SCRAPER LOADING.

FIG. 28.—CARRYING OFF THE FULL SCRAPER.

REMOVAL OF EARTH BY MEANS OF SCRAPERS.

by the horses completes the tipping movement, bringing the scoop into the position shown in Fig. 25, in which position it is held by the forward hook catching on a lug on the upper edge of the rear wall of the scoop. The empty scraper is carried back to the loading ground in the position shown in Fig. 25, and then the workman pushes the scoop forward slightly until the front hook is free and the scraper swings into the position shown in Fig. 15.

To load the scraper the workman takes hold of the long arm of the lever with his right hand and presses it far enough down to release the back hook, allowing the scoop to sink at the rear. Then the workman takes hold of the handle on the left side of the scoop with his left hand, at the same time raising the lever with his right hand and bringing the scoop into the position shown in Figs. 17 and 26; and then the loading begins, the workman regulating the height of the scoop above the ground with his right hand, while he regulates the inclination of the scoop with his left hand. For loading all but the smallest scrapers two men are required, the second operator taking hold of the lever with his left hand and of the handle on the right side of the scoop with his right hand.

To prevent tipping during the loading operation, the larger scrapers are each provided with a hook, which is so connected with the drawbar that when the scoop has reached the proper position for loading, the hook catches on a projection on the outside of the scoop near the front flange. Figs. 24, 25, 26 show this hook, but in the construction shown in Figs. 18 to 23 the hook is on the scoop, while the lug which it engages is on the drawbar. These figures also illustrate the method of attaching the horses to the scraper when more than one team is needed, which is always the case when a large scraper is used in heavy ground.

The plan for working with the wheel scraper is simple. The loading ground is divided into sections which are worked alternately with the plow and the scraper. With these, as with the drag scraper, the earth is removed in layers as thick as the furrow is deep. Steep inclines and uneven surfaces are avoided.

Besides the scrapers described there are others in use, among them the one employed in Elyria, Ohio, which is the drag scraper, almost without alteration, hung from the axle by means of chains. The driver, who sits on the scraper, raises and lowers the scoop during the forward movement of the apparatus.

The wagon scrapers are much used in the United States for repairing roads, especially in the spring. The road is first plowed up and then the earth is moved from the sides to the middle of the driveway, with ordinary scrapers or with wagon scrapers, thus giving the road the desired shape, with the ditches at the sides. The loose earth is then packed by means of a street roller. Figs. 33, 34 and 35 show these scrapers.

Less preparation is required for the removal of earth by scrapers than for any of the other methods employed, and four-fifths of the workmen have light work. Only those who guide the plows and load the scrapers need to be especially strong or skillful men. Perhaps the steam plow could be used to advantage, and it seems as if improvements might be made in the construction of the scraper which would lighten the work of the loader, the greater part of the hard work being done by the horse. The idea of using the scraper is to do the heavy work of loosening, loading and removing earth by horse power, as much as possible, in places where steam power cannot be employed. This method offers special advantages for the removal of earth in tropical countries.

Of the numerous manufacturers of scrapers, we mention the following: The Kilbourne & Jacobs Mfg. Co., Columbus, Ohio. (Figs. 18–23.) The Western Wheel Scraper Co., Mt. Pleasant, Iowa. (Figs. 1, 2 and 14–17.) The Fry Manufacturing Co., Elyria, Ohio.

The different constructions are covered by numerous patents.

Abstract from the *Zeitschrift des Archit. und Ingen. Vereins zu Hannover.*

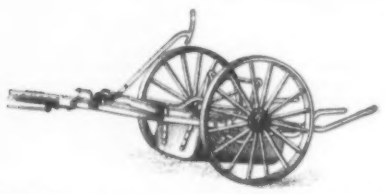


FIG. 29.—SCRAPER WITH CLOSING PLATE, LOADED.

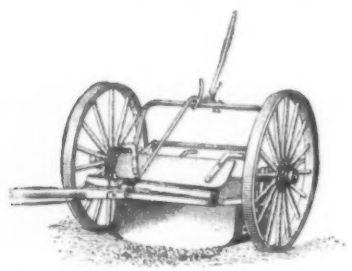


FIG. 30.—SCRAPER WITH CLOSING PLATE, IN POSITION FOR LOADING.

FIG. 32.—CLOSING PLATE.

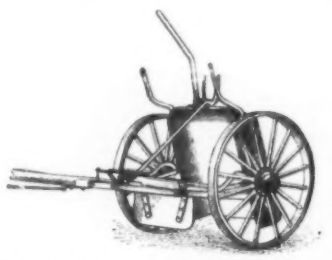


FIG. 31.—SCRAPER WITH CLOSING PLATE, EMPTY.

FIG. 33.

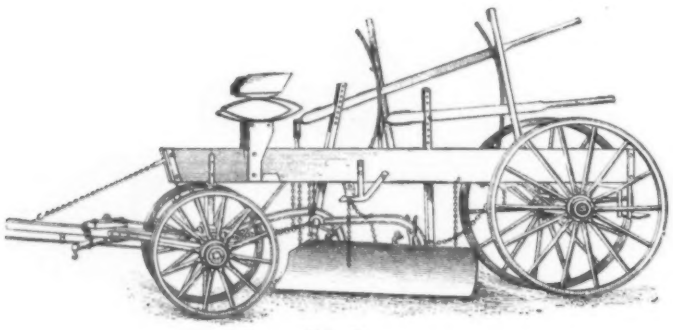


FIG. 34.

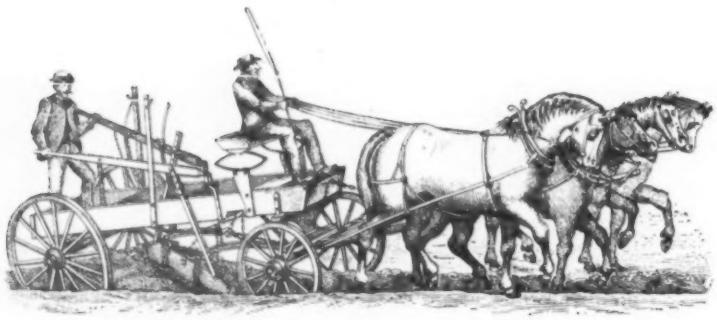


FIG. 35.

FIGS. 33, 34, AND 35.—THE WAGON SCRAPER BUILT AT MT. PLEASANT.

REMOVAL OF EARTH BY MEANS OF SCRAPERS.

ELECTRICAL UNITS OF THE PRESENT AND FUTURE.*

By Prof. FRANCIS B. CROCKER.

THE subject of my lecture is unfortunately but necessarily a dry and somewhat difficult one. My only excuse for presenting it to you is the fact that it is certainly a matter of fundamental importance, and also that it is one about which most electrical men are, to say the least, not perfectly and clearly informed. It is a matter which usually one has no opportunity to learn. When most of the men in the electrical profession obtained their education they picked it up, so to speak, as there were no regular courses of electrical instruction. In picking up information it is usually very hard to get, and one is apt to postpone it. No time comes for sitting down and finding out how the electrical units were derived, what they mean, and how they are related to each other, etc., etc.

The complicated and unattractive condition of the subject of electric units is partly due to the fact that is a growth and partly due to the fact that it is naturally and inherently a heavy subject. If to-day a system of units were to be devised, it would probably not be the present one. But the best system that could be devised would be difficult and complicated.

The matter of units and electrical measurements is precisely similar to all other measurements. What is true of electrical measurements is true of others; in fact, electrical measurements are derived directly from ordinary measurements. If we go back historically to the origin of the subject, we find that in ancient times men did not require exact measurements. Numerous facts were presented to the view then as now, but men were satisfied with rough ideas. For example even at the present time we know a physical fact just as well, whether we measure it or not. I know the existence of the Hudson River or the Capitol at Washington just as well, whether I measure it not. I think that it is a point that is not generally realized—the fact that we may perfectly and clearly know a thing without measuring it, although physicists are apt to think that unless we measure it we know nothing about it. But as soon as we come to definite work, either in science or commerce, measurement is everything, and the mere existence of the thing is of little consequence compared with its value. For example, in the case of a steam engine, the whole question is whether it is one or twenty or a thousand horse power. Its mere existence is not important, and no one would buy a steam engine, or think of considering a steam engine, except in the most careless way, without knowing its power. It depends on circumstances whether we need measure things or not.

To measure quantities of any kind some unit is needed. In the crude ancient days that I referred to, the roughest kinds of units were sufficient. The length of the king's foot, of a barleycorn, or the side of some temple, or a stone in a pyramid, or something of that sort, were quite good enough for a unit. In fact, nothing better was needed. But as soon as the exact sciences developed, astronomy, mechanics and other branches of science, and when commerce became more important and definite, the necessity for some more exact unit arose. The rough units I refer to are not only rough, but they are arbitrary. They might just as well select some other king's foot or some other stone in the pyramid, instead of the particular one selected. The more exact requirements of advanced work at first only required definite standards. Therefore the standard yard and the standard quart were adopted, but they were arbitrary. Some persons decided what they should be, and they were carefully made and deposited in the national archives, and exact copies of those were made and sent around to various points, and they became in some cases the legal standards.

Standards can be adopted by custom or by law. Some of the standards in common use are legalized and some are not. One or more of our most common standards have not been legalized.

So far they had merely arbitrary units. The quart bore no relation to the yard; the yard bore no relation to the second, and neither of the three bore any simple relation to any other unit. That is to say, the fraction representing the relations between the two would have several decimal places. But, nevertheless, each was definite in itself. The standard yard was a definite length of metal and carefully preserved. Therefore, it was as exact as any unit can possibly be, but it had the disadvantage of having no simple relation to any other unit, and when we pass from yards to quarts and from quarts to pounds, etc., we have no convenient way of translating the quantities. We are obliged to use very awkward figures. What is needed is an *absolute system* in which the units bear exact and easily remembered relations to each other. That is the essence of what is called the absolute system. But it happens that an absolute unit is a very hard thing to obtain. It is impossible to look about and find a standard length that is derived from any source that is unquestionable. It is a matter of judgment and choice, and nothing seems to be very satisfactory for the purpose.

The waves of light would be one of the most definite and one of the most ideal sources of a system of units. Each particular point of the spectrum has a definite wave length, and it also has a definite wave rate. That would give us a unit of length and a unit of time, and from one single phenomenon we could get two units. But when the absolute system was established, the wave length and wave rate were not understood; and if you will consider the thing for a moment, you will see that it is almost impossible to think of any absolute unit—anything that will be as true in Asia as it is in America, and also as true a thousand years hence as it is to-day. That is what an absolute system requires. They simply selected the best absolute unit they could get, and they were forced to take a unit based on the size of the earth. But this is not a good unit, on account of the difficulty of measuring the earth. It is so

* Address before the New York Electric Club, Dec. 13, 1890.

large that it is extremely difficult to measure it. The first question in this system of absolute units is, What units have we got to determine? This is largely choice, and it so happens that, if we fix a few units, we fix all the others. The others can easily be derived. The three facts in nature which are supposed to be absolute, and that philosophers look upon as the three fundamental conditions of existence and thought, are time, space and matter. These three facts are supposed to be fundamental, and everything else is a combination of them. This may be true, or it may not be true; but so far as matter is concerned, it is a question whether there is such a thing at all. It is impossible to know of it directly. We only know of matter through force. For instance, where we take a brick—one of the most tangible things one can think of—the reason we know that it contains matter, or think that we know that it contains it, is that it is rigid, which is entirely due to the force of cohesion of its particles. One can quibble about this forever, as with most other metaphysical questions, and it really does not make much difference either way. The existence of matter may be somewhat questionable, but of course there is something there that we can call matter, and we know there is time and we know there is space.

Therefore, time, space and matter were selected as the fundamental quantities, and it was necessary to find a unit for each.

Taking space or length, which amounts to the same thing, as the first, they began by measuring the circumference of the earth, or rather a quarter of it—the earth's quadrant—which is the distance from the pole to the equator. Of course, the actual distance from the pole to the equator was not measured; they measured one degree of it, and calculated from that. These measurements were carried on with the utmost care. It took months and months of the most careful work to make them. The metal bars were laid on the ground perfectly horizontally. The temperature had to be carefully taken. The bars had to be exactly in contact, that is, just touching each other—not enough pressure to produce any strain. It would probably take days to travel a few hundred feet, and to travel 60 miles and make an exact measurement of that sort, and expect to come out within a few inches, would require exceedingly careful and protracted work. Unfortunately, an error was made that would not be of consequence in anything else, but in the case of the foundation of a system of units it amounts to something—about one one-hundredth of one per cent. Nevertheless, from that measurement the unit was determined. But the question arose what fraction of the earth's quadrant to take as the unit. Of course, it must be a round number. A ten-millionth happens to be about equal to a yard. A one hundred-millionth would be too small—about four inches. One is a little too small and the other is too large for a convenient unit of length. The foot, which is a very convenient unit of length, is between the two, but unfortunately the earth did not lend itself to this system of units. They chose the larger one, and made the meter the standard of length. The meter is simply one ten-millionth of the earth's quadrant, as measured by the French authorities. They made exact copies of it and deposited it in Paris, which is the center in regard to metric matters, and the various national governments are supplied with exact copies of the standard. An exact copy was sent to the United States not much more than a year ago It was opened by the President of the United States in the presence of the officers of the government, and was a matter of considerable importance.

Having the meter, the question was to get a unit of weight. The unit of weight may easily be gotten by cubing—that is, making a volume from the unit of length and filling it with water. But a cubic meter of water would, of course, be too large for a unit of weight, as it weighs about a ton. So a fraction of it was taken. Here, again, a choice was necessary. A cubic centimeter of water was selected and called the gramme. I think that was a great mistake, because a centimeter is a very small thing, and has tended to bring the whole system of absolute units into disrepute. It seems so small that it is not worth considering. I think if they had taken the decimeter, the tenth of the meter, as the unit of length, and the cubic decimeter of water as the unit of weight, we should have very much better and more harmonious units. A meter is too large and a gramme too small. The unit of time has already been selected. The second is simply the ordinary second that is used in calculating time all over the world, and is also a very small unit.

Thus we obtain the three primordial standards of length, mass and time, and since, for scientific purposes, the centimeter is taken instead of the meter, we have the centimeter, gramme and second as the three fundamental units upon which is based the C. G. S. system of units. Theoretically, and probably practically, all units of every kind, present and future, can be derived from these three simple fundamental units, which we can all understand and know just how they were obtained and what their values are. The mechanical units are very easily derived from the fundamental units. To obtain velocity, we divide length by time; that is to say, we do the same as in any other case when we say so many miles per hour, so many feet per second, etc. Acceleration, of course, is the increase of velocity. That is to say, it is distance divided by time, which is velocity, and that divided by time again, because if we increase the velocity in a certain time, that is acceleration. Force is giving acceleration to a mass, which is the Newtonian principle of measuring force. Work is simply force multiplied by distance, which again is well known. To take one pound and lift it two feet requires two foot pounds, and so on. The electrical units are almost as easily derived, but the question is what to start with.

There are two fundamental laws of electricity. One is Coulomb's law, which applies to static electricity, and states that a certain charge of electricity attracts or repels another certain charge, with a force directly proportional to the product of the quantities and inversely proportional to the square of the distance. In former times static electricity was very important. The old books were full of dolls with hair standing on end, pith balls, etc.

It happens now that static electricity does not amount to much. There is no force in it. A spark passes, and that is the end of it. We need something more constant than that. So when electricity is to be used, it should be in the form of current which lasts. The fundamental law of the electric current is that of Ampère, which states that a current affects a magnet in proportion to the strengths of the magnet and of the current, the length of the wire, and inversely proportionally to the square of its distance from the magnet. As we can measure the length of the wire and the square of the distance, hence we can get the strength of the current.

But this involves having magnetic units. Here are two bar magnets supposed to be exactly alike. If I bring the north poles together they repel each other; and if the magnets were delicately suspended on silk fibers, and brought within a unit's distance, and the repulsion between them accurately measured by the torsion of the fiber or by balancing them against some other known force—a delicate spring—then I would find how many units of pole strength the magnet had. To get a unit magnetic field from this, we say that a unit pole placed at a unit's distance produces a unit's strength of field. The field is the important thing in dynamo machines and many other practical cases.

To get a line of force, which, by the way, is the unit that is most used in practice, we produce the unit field and take a unit's area of it, which is called line of force. It is to a certain extent arbitrary, but it is definite, nevertheless, and that is the line of force that we use so much. We read of it in text books and even in the daily papers.

To return to measuring the current. We take a unit pole, and when it has a unit of force exerted on it by a unit length of a current at a unit's distance and a unit length, then it is a unit current. Thus we pass from the quadrant of the earth to the unit of the current by several simple steps, each one of which is easy to understand and each one of which is perfectly logical and follows directly from the previous one.

From current, which is, in my opinion, the fundamental unit of useful electricity, we obtain quantity of electricity. Quantity of electricity is simply the amount of electricity that flows in a unit current for a unit time. Now, electromotive force is about the most troublesome one of these units. It means the tendency for electricity to produce a current and do work. Therefore, electromotive force multiplied by quantity of electricity would give you the work. If I have a certain electromotive force and one unit of quantity, I will have a certain work that will be measured by the electromotive force. It is exactly like steam. I can have 100 pounds pressure of steam and one cubic foot of steam; I will have a certain amount of work. If I have two cubic feet of steam at the same pressure, I will get twice the work. Conversely, if I have 50 pounds pressure and two cubic feet, I will have the same amount of work, practically—a little less in the case of steam—as if I had 100 pounds pressure and one cubic foot. In other words, the product of the pressure or electromotive force by the quantity is the work. Therefore, to get the electromotive force, divide the work by the quantity.

Ohm's law gives the resistance as equal to the electromotive force divided by the current, these last two being known. From here on the derivation of the rest of the units is a mere clerical matter. For example, taking capacity as the next unit, we find it equal to quantity divided by potential; that is, the unit of capacity will hold a unit quantity at a unit potential. Work, as I have already explained above, is equal to potential times quantity. Power is rate of work. Therefore, potential multiplied by current, quantity per second, is power.

We now come to self-induction.

Self-induction is somewhat unfamiliar, nevertheless it is becoming important. Self-induction in telephone work, aerial, underground and submarine lines, dynamo armatures, dynamo field magnets, transformers and other alternating current apparatus, are all practical cases of self-induction. We should consider self-induction almost as much as resistance. We have not done so heretofore, but that is no reason why we should not in the future.

It happens that there are several ways of defining self-induction, but the best way, I think, is to consider it as a counter electromotive force. That is to say, when I send a telephone current through an electro magnet, the latter reacts against the current. When the current tries to go through, the magnet tries to oppose it. Therefore, the best way to define the unit self-induction is to say that it gives a unit counter electromotive force when there is a unit change of current in a unit time. The ordinary way, however, of deriving this unit is to multiply resistance by time. That seems to be an odd way to get it, but what it means is this: That self-induction is the apparent increase in resistance that we get when we try to pass a current through a circuit. If I put a current through the field magnet of a dynamo machine, it will take some time before it reaches its full strength. The magnet will resist the current very much more than the mere resistance of the wire, if it were stretched out in a straight line, due to the fact that it is formed in a coil around a piece of iron. But after the current has got flowing, so to speak, then self-induction ceases to exist. It only occurs when a change is taking place.

The absolute units have no names, they are simply designated as absolute units of electromotive force, resistance or quantity, as the case may be. This means that they are derived directly from the centimeter, gramme and second, and "dimensions" of units are mathematical ways of expressing how these fundamental quantities enter each unit. Some of them involve all three of these quantities, some involve two, and some only one. Take, for instance, area. Area is L square; that is, the square of the length; for example, a foot square is an area. Volume is L cube. Velocity is L divided by T. That is, it is L multiplied by T to the minus one power. This enables us to put them all on the same line for convenience.

We come now to the practical units. Every one of these absolute units, derived as I said, are either so small or so big that they are not useful.

It was necessary to take a certain number of a fraction of an absolute unit. In the case of resistance they took such a number of absolute units in round numbers as would most nearly approach the Siemens unit, which had been used before, and it happened to be 10^9 absolute units, which means that a billion of these little bits of absolute units will make one ohm, the practical unit of resistance, naming it after the discoverer of Ohm's law, and establishing the precedent of naming all the electric units after distinguished electrical scientific men, which rule has been followed without exception to the last unit. They call 10^8, that is 100,000,000 absolute units of electromotive force, a volt. That approximated most closely in round numbers to the Daniell cell, which had previously been used as the unit of electromotive force. They selected the nearest units to the two units already in existence, and having fixed those, the theoretical value of the ampere followed. It is one thing to select how many practical units you will have in one practical unit and it is another thing to determine it. The whole system could have been originated without making a single experiment. The ampere can be determined experimentally very much more easily than the volt or ohm, as I said, by balancing the effect of the current on the magnet with some known force. Now, it happens that we know the force of the earth's magnetism. It is not at all difficult to find out by suspending a magnet, determining its time of swing and moment of inertia. Having determined the earth's magnetism, all you have to do is to balance the current effect on a magnet with the earth's effect on it, and knowing the earth's effect we know the current's effect, and, therefore, know the value of the current, which is the whole principle of a tangent galvanometer.

Thus the tangent galvanometer will give us the value of the current in absolute units, and if we take 10^{-1} of these we get the value in amperes. This is because the volt is 10^8 and the ohm is 10^9. Therefore, dividing one by the other, in Ohm's law, we obtain 10^{-1}. Having arrived at the current absolutely, we can also determine how much metal a current will deposit. But we cannot calculate it absolutely, however. We must determine it. I have here the exact weight of silver that one ampere will deposit in one hour. It was carefully weighed by the assay department of the School of Mines, and it is right to the tenth of a milligramme and weighs 4·0248 grammes. The ampere is a unit that is easily determined. The volt and the ohm require laborious work of years, and the original ohm as determined by the British Association committee was about 1¼ per cent. wrong, which is a pretty bad mistake for a scientific measurement.

In making actual standards of these units, the volt is the most elusive one of all. The tangent galvanometer and the silver deposition give up the ampere pretty well, and for the ohm we have a definite coil. But the volt is dependent on standard cells containing chemicals that are very apt to change. They are compounds and they are apt to decompose or change in their composition.

It happens that the unit of capacity, the farad, is a very large unit and we have to take a millionth of it to get working unit. The microfarad is the standard, and it is a pretty good size standard. It is equal to the capacity of two or three miles of the Atlantic cable. It would contain the same quantity of electricity as two or three miles of Atlantic cable, and it would take a thousand Atlantic cables to equal one farad in capacity. Therefore, you see that what is called the "practicable unit" of capacity is very impracticable. The reason the farad is so large is that we have obliged ourselves to define units in terms of one volt, one coulomb, etc. Now, with static electricity, one volt is very small. Our ordinary static charges are 100,000 volts or more; for instance, it takes about 100,000 volts to spark one inch.

Now a static spark to jump an inch is not a particularly large one. These, to take the volt to determine the unit of static capacity, make it necessary to have a tremendous capacity to hold one coulomb at that very low electrical pressure.

I would like to point out the fact that we have "absolute units" and "practical units," so called. I put both of these in quotation marks. Absolute units, as I have said, are not absolute, they are based on an arbitrary dimension of the earth incorrectly measured. Now, practical units in the same way are not practical, because we have one, the farad, that is 1,000 times greater than the greatest practical capacity in existence. Therefore, I maintain that we must have a third system of units, and that is the "working" units. You could call them "commercial," but the objection to that is that they are equally used in the laboratory as in commercial work. We use a microfarad in the laboratory the same as in the office of a telephone or cable company. Therefore, they are not, strictly speaking, commercial, but they are *working* in both cases. Sometimes the working units agree with the practical and sometimes they do not. The ampere, coulomb and volt are the same, although in telegraphy we use the milliampere. Then we come to the ohm. That is, the ohm is right for most practical work, but for insulation tests we have to use a megohm. Nobody thinks of giving insulation tests except in megohms. Therefore, for that class of work, the working unit is the megohm and not what is called the practical unit.

When we come to the microfarad there is no question. The practical unit ceases entirely to be practical, and we have to adopt the working unit, which is almost infinitely different.

The watt is a convenient unit for a great many purposes, but when we use it for large work we use the kilowatt, which, by the way, is a good way of rating dynamos, because it is fairly near a horse power.

Then we come down to the last of all—the henry, the new member of the family, and it is a question whether the working unit will be a henry or a millihenry. I did think of reducing the value of the henry to 0·001 of its value as given in the table; but it would have been a mistake, for the reason that, instead of having its value one second multiplied by one ohm, we would have its value a second multiplied by a thousandth of an ohm or a hundredth of an ohm. That would be destroying the simplicity and the harmony of this system—a feature which it certainly does possess. Every one of these units is derived from every other one in the simple ratio of one to one, and in no case is there any complex relationship of a thousandth or ten-thousandth or anything of that sort. You see that the coulomb is an ampere multiplied by a second, a volt is one ampere multiplied by an ohm, a farad is a coulomb divided by a volt. A joule is a volt multiplied by a coulomb, and a henry is a second multiplied by an ohm; and to make any one of them anything would, I think, be a mistake, particularly as it would have been the only exception to the harmoniousness of the system.

Fortunately, the henry approximates a practical value. For example, a large Edison dynamo, shunt wound, will run up to one or more hundred henries,

A telephone magnet will be between 0·01 and 0·1 of a henry. We could not expect that to be a very large value. An ordinary relay is several henries in value. A large induction coil is often 1,000 or more henries in value. Therefore, there is nothing preposterously small or large about the henry. It is about right. I have given in the last column of the table the actual or experimental value. That is, 4·025 grammes of silver per hour is the ampère. The volt is 0·926 of a Daniell cell. The legal ohm is 106 centimeters of mercury one square millimeter in cross section, etc. The unit of self-induction is equivalent to the length of the earth's quadrant. Thus we see that after starting with the earth's quadrant in this system of units, to obtain the fundamental units of length, and passing through all the mechanical units, and the electric units, we finally get back to the earth's quadrant again. It is certainly quite remarkable and striking. It is a fact, nevertheless, that the unit of self-induction is properly represented by a length equal to the earth's quadrant. In fact, it has been called the quadrant and was so called by the Paris conference, which, I think, was a great unfairness to American electrical men, both living and dead, because certainly America's contributions to electrical science and industry have been fully equal to those of any other country, and if England has the farad, joule and watt, named in honor of her distinguished electrical scientists, if France has the coulomb and ampère, if Germany has got the ohm, and if Italy has got the volt, I think it is certainly not unreasonable for us on this side of the Atlantic to ask for one unit, to be named after the discoverer of self-induction, Joseph Henry.

In regard to future units, which the requirements of advanced work will soon necessitate, we need a unit of the strength of a magnetic field. We can express it as so many lines of force to the square centimeter, etc., but that is a very clumsy way. If we simply call it one Franklin, it would be very preferable to a long sentence. We all have in mind the naming of some electric unit after Franklin, but unfortunately Franklin is not identified with magnetic work. He is identified with electrostatic work, but all the electrostatic units have been named. But, perhaps, his name may be adopted. We shall certainly require within a short time a magnetic unit defining the number of lines of force, and we will speak of a field as so many units, and we will have a name for it; and when we use it every one will know what we mean. The naming of a new unit and giving it its value and deciding what it shall be, are very difficult questions. An error might cause considerable trouble and loss of time and all sorts of bad results, whereas the proper selection of a unit would greatly facilitate work.

This treatment of units is necessarily superficial, and all I have attempted to do is to show you the general derivation of them, starting the very first conception and coming to the present time and a little beyond; in fact, by giving you some inkling of what the probability of new units is.

RECENT DISCOVERIES AT THEBES.

EGYPTOLOGISTS will be pleased to hear of the discovery of a vault filled with mummies and funereal coffers at Dayr el Bahree, near the plain of Thebes. It was not far from this spot that M. Maspero found the royal mummies of the kings of the nineteenth and twentieth dynasties in 1881. The new excavation, from which already 200 mummy cases have been taken, also seems to have been a cachette or hiding place rather than a tomb. At a depth of about 30 ft. a gallery diverges, and in it the mummies were packed, the entrance having been blocked with wood and cloth, both of which are in good preservation. Two other galleries have still to be explored, probably they are also quite full. The removal of the cases is under the superintendence of M. Gribeaux, from the Geesch Museum. Eight or ten of the fellaheen bear each of the heavy cases on their shoulders, chanting the song which is always heard when a number of men work together, and after frequent intervals of rest the procession arrives at the barge which has been sent from Cairo. It will be impossible to decipher the many rolls of papyrus for some months. So far, it has been ascertained that the mummies are chiefly those of priests and priestesses who lived in the twenty-first dynasty, or about 1100 B.C. A high priest of the god Amen, named Hirhor, was the founder. This may, perhaps, account for the elaborate way the mummies have been preserved; also for their removal from the original place of burial, either at a time when the tombs were being searched for treasure, or perhaps during the reign of Shashank, the son of Nimrod, who overthrew the priestly rule.

MUMMIES FROM THE RECENT EXCAVATIONS AT THEBES.

These particulars are communicated in a letter from Mr. Killingworth Hedges, civil engineer, writing on Feb. 11, at Luxor.—*Illustrated London News.*

BRINGING THE MUMMIES FROM THE RAMESEUM, AT THEBES.

THE BLACK KNOT OF PLUM AND CHERRY TREES.

By BYRON D. HALSTED, Botanist and Horticulturist.

THIS bulletin has a double purpose: first, to impress upon the minds of the fruit growers of the State a full knowledge of the nature of the disease of cherry and plum trees commonly known as the black knot; and, secondly, to induce such action upon the part of all interested, as will lead to the destruction of infested trees, and thereby render it possible to grow two of our choicest orchard fruits with pleasure and profit.

It is not proposed to here give the results of any original investigations upon this pest, for its exact nature and habits of growth and propagation have been worked out fifteen years ago by Dr. Farlow, and the results published in the Bulletin of the Bussy Institution, with three full page lithographic plates.

The common name of the disease is taken naturally from the black, wart-like growths that appear upon the twigs and branches of various species of plum and cherry trees. The black knot was so abundant in 1875 in the Eastern States that Dr. Farlow wrote as follows in the opening paragraph of his elaborate paper: "An idea may be formed of the small crop of plums now raised in New England from the fact that two dollars and a half were given in Boston last autumn for a peck of damsons for preserving. In some parts of New England, particularly in Maine and along the sea coast, the raising of cherries has also been almost abandoned in consequence of the ravages of the black knot." These discouraging words apply with equal force to-day, and over a wider area than New England. In my journeyings through New Jersey during the past season the impression deepened into a firm conviction that the time was ripe for something systematic, thorough and effective to be done in eradicating this fatal disease of our plum and cherry trees.

In the first place, let the reader get a clear understanding of the nature of the enemy that it is proposed to conquer. There is no question whatever about the black knot being caused by a low form of vegetable growth called a fungus, that sends its minute threads through the substance of the twigs and branches. It is, therefore, necessary to gain a knowledge of this fungus, and for this purpose the accompanying engravings have been prepared.

While it is generally assumed that the appearance of a diseased tree is familiar to most of the readers, it has been thought wise to give illustrations of two badly infested trees, that no question in regard to the matter should remain in the minds of any. When the leaves are off, the excrescences are conspicuous, and often so numerous as to greatly disfigure the dying tree, as shown in Fig. 1. This engraving is from a photograph of an old cherry tree, the larger part of which has been cut away from time to time on account of the ravages of black knot, and the remaining portion should be at once consigned to the flames. Fig. 2 is from a photograph of a young plum tree made worthless by the ravages of the same fungus, and as it stood within a few rods of the old cherry tree shown in Fig. 1, probably was infected by spores from it. The knots themselves vary in size and shape, some extending entirely around the twig, while others grow lengthwise of the branch upon one side, and cause it to become bent, sometimes almost double, in which case the portion

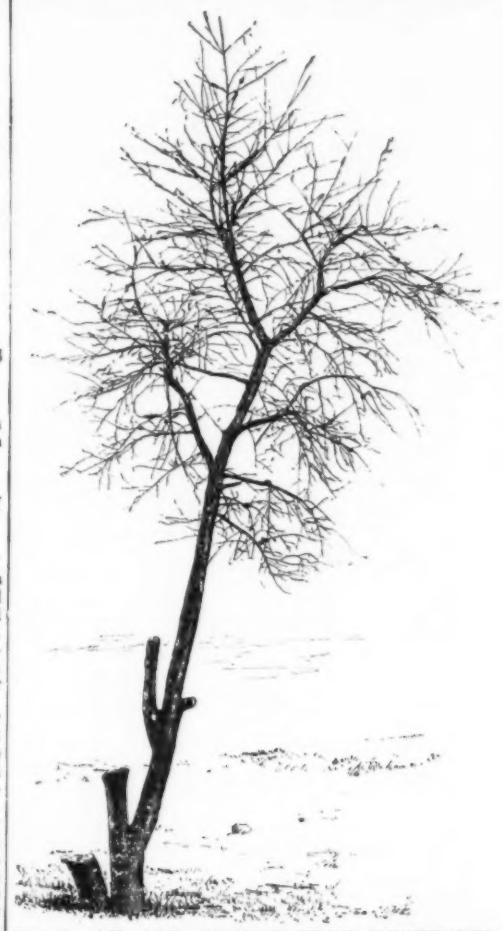


FIG. 1.—AN OLD CHERRY TREE DESTROYED BY BLACK KNOT.

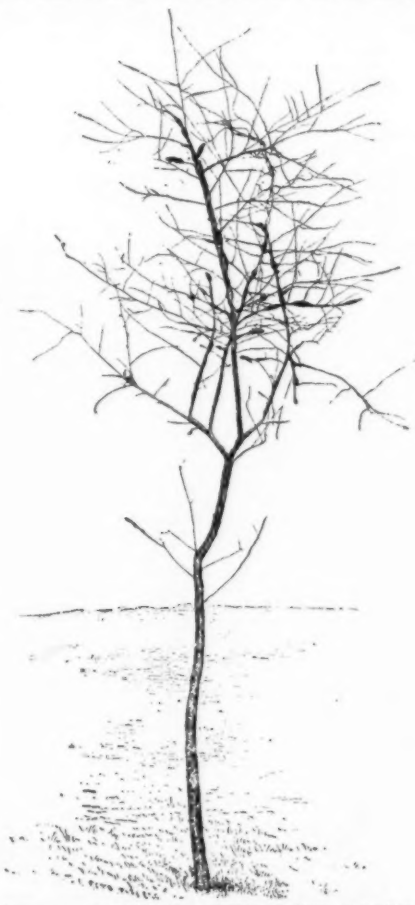


FIG. 2.—A YOUNG PLUM TREE BADLY ATTACKED.

above the excrescence dies. The surface of the old knots that have been extending from the first point of attack perhaps for years consist of a black undulating crust that finally breaks up and exposes the worm-eaten interior. An average knot that has been three or more years in growing is shown in Fig. 3, with the cracks that have developed from time to time.

FIG. 3.—AN OLD KNOT (NATURAL SIZE).

The beginnings of a young knot are first seen in a manifest swelling of the young twig, which is soon followed by a cracking of the bark, and in the rifts thus formed the threads of the fungus come to the surface and clothe it with a covering of olive filaments bearing multitudes of spores. A young branch is shown in Fig. 4 that exhibits the characteristic swelling of the initial knot and the cracks in the bark in which the spores are borne. A highly magnified portion of a rift in the bark is shown in Fig. 5, in which the superficial stalks and their spores are seen. The spores are carried in all directions by the wind, and falling upon the surface of young shoots, germinate, send their filaments through the bark into the growing ring of soft tissue beneath and institute another knot.

FIG. 4.—A FORMING KNOT.

As the season advances, the young knots and the fresh growth of older ones lose their olive, velvety appearance, turn of a dark color and develop a hard incrustation upon the surface. Within the substance of this black and brittle layer many spherical pits are formed, as shown in Fig. 6, and as winter advances, minute sacs are produced upon the wall of the cavity, that toward spring bear each eight oval bodies that are

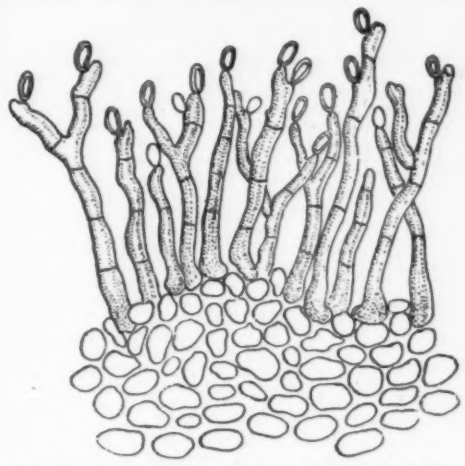


FIG. 5.—A PORTION OF A YOUNG KNOT, HIGHLY MAGNIFIED.

known as sac spores. These escape from their long sacs and pass out through a pore at the top of the cavity, and are then ready to be carried by the winds to the surface of a young cherry or plum twig, and thus begin another knot, which, in the course of time, produces a new crop of summer and another of winter spores, and thus the disease is preserved and propagated. In Fig. 7 is shown two of the sacs with the eight spores in each. A free spore is also shown in the process of germination. The last three engravings are redrawn

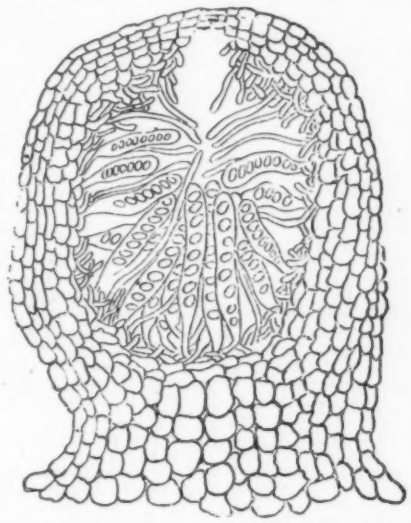


FIG. 6.—MAGNIFIED VIEW OF SPORE CAVITY.

after cuts by Dr. Farlow in the paper previously referred to. It is a fact that cannot be too emphatically stated here that the ascospores above mentioned are matured during the winter months, and that they will continue to ripen when the knots have been removed from the tree and left undestroyed upon the ground.

There are other forms of spores besides the two already pointed out, but their presence or absence does not change in the least the treatment that should be given to diseased trees, and, therefore, may be omitted

FIG. 7.—TWO SPORE SACS, AND A FREE SPORE GERMINATING.

from this special appeal. The fact of their existence only strengthens the previous conviction that in the black knot we have a fungus perennial in its character and wonderfully provided with methods of spore formation for the rapid spreading of the malady at all seasons of the year.

A very practical point in this connection is the range of species upon which the black knot occurs. There is probably no variety of cultivated plum that is exempt from it. On the other hand, some sorts of garden cherries do not seem to be subject to the devastating influences of the black knot. The morello and mazzard sorts are the most susceptible, and, therefore, at present there is little encouragement to grow them. But the pest is not confined to the cultivated varieties of plums and cherries, and this fact adds considerably to the burden of eradicating the evil, making systematic effort all the more imperative. The following are the wild species of plum and cherry that suffer from the attacks of the black knot: The chickasaw plum (*Prunus Chicasa*, Michx.), a comparatively rare, thorny, dwarf tree, found along the banks of the Delaware River, where it has crept in from the Southwest. *Prunus maritima*, Wang., the beach plum, is a low, thorny shrub common on the sandy sea coast and frequent in the pine barrens of the State. The wild yellow or red plum (*Prunus Americana*, Marsh) is a third species of plum, a small, thorny shrub or small tree, frequent along streams in the middle and northern counties, that does not escape the ravages of the black knot. Of the cherries, the *Prunus Virginiana*, L., or common choke cherry, a small tree, is the most generally infested. The wild black cherry *Prunus serotina*, Ehrb.), a good sized forest tree, often seen along fence rows, is susceptible. *Prunus Pennsylvanica*, L., the wild red cherry frequently found in the northern parts of the State, is also subject to attacks.

There are, therefore, at least eight species of the genus Prunus that are more or less affected by the black knot, and there seems to be no doubt but that all are attacked by the same fungus, namely, *Plowrightia morbosa*, Sacc., and that one kind of prunus may take the disease from any of the other seven susceptible species. There are only two other kinds of prunus in the State, namely, the sloe or black thorn (*Prunus spinosa*, L.), not widespread, and the dwarf cherry (*Prunus pumila*, L.) of the rocky hills of the northern counties. The general appearance of the knots varies somewhat among the various species of prunus, which has led some to think that they were not all caused by the same fungus, but it has been demonstrated by direct inoculations that the spores from the knots of the choke cherry will produce the quite dissimilar excrescences common to the garden plum, a fact that in this connection it is important to know.

To those who have held the opinion that the knots are produced by insects—and this is not an unnatural view of the matter, for many excrescences, galls, etc., are due to them—it may be well to reproduce the argument used by Dr. Farlow in his paper before referred to:

"First, the knots do not resemble the galls made by any known insect. Secondly, although insects, or remains of insects, are generally found in old knots, in most cases no insects are found in them when young. Thirdly, the insects that have been found by entomologists in the knots are not all of one species, but of several different species, which are also found on trees which are never affected by the knot. On the other hand, we never have the black knot without the *Sphæria* [*Plowrightia*] *morbosa*, as was admitted by Harris, and the mycelium of that fungus is found in the slightly swollen stem long before anything which could be called a knot has made its appearance. Furthermore, the *Sphæria morbosa* is not known to occur anywhere except in connection with the knots." The proof of the nature of the cause of the trouble is complete, and it only remains to consider the most satisfactory method of eradicating it.

In view of the fact that it infests several species of wild plums and cherries, is abundantly provided with means for spreading from one kind of prunus to another, and is perennial where once introduced, it cannot be hoped that it will be driven out except by concerted and thorough efforts upon the part of fruit growers of the State.

The remedies to be proposed are few in number, and easily applied. The old one of removing all the knots with a knife and burning them is highly recommended. However, when a tree is thoroughly infested, it is not easy to cut far enough below the excrescence to remove all the fungus. The writer has frequently seen vigorous trees, highly prized by the owner, so severely pruned as to leave only a few stubs in place of the branches, and upon the tips of each the next season would grow knots of considerable size. In all such cases there seems to be only one thing to be done, and that is to remove the whole tree and cast it into the consuming burn-heap—the sooner the better.

At the Massachusetts Experiment Station this serious pest has been under consideration, and the application of various substances to the knots fully tested. Thus, linseed oil, turpentine and kerosene were severally applied to the galls to saturation with a brush at different times during the summer. They "all effectually destroy the plum wart," but the turpentine and kerosene must be used with great care, or the branch will be killed. No such injury follows the application of linseed oil. It is suggested in the bulletin (No. 4) containing the above results that a solution of sulphate of copper applied with a hand pump in early spring to the whole tree, and more concentrated with a brush to the forming galls later in the season, may prove effective. In a later bulletin (No. 6), the painting of the knots with a mixture of red oxide of iron in linseed oil it is stated has given good results. We read further in this bulletin that a very serious difficulty in dealing with the pest in question is presented by the fact that while one fruit grower may do his part in the eradication fully and well, a lazy or thoughtless neighbor lets his infested and worse than worthless trees remain to breed the contagion for the whole neighborhood.

The writer being fully aware of this state of affairs, wrote the following paragraphs for the *Garden and Forest*, published in the issue of April 16, 1890:

"WHY NOT LEGISLATE AGAINST THE BLACK KNOT?

"There are some good reasons for legislating against the black knot (*Plowrightia morbosa*) of the plum and cherry trees. In the first place, the fungus is beyond question extremely destructive; whole orchards of large size in many parts of the country have been abandoned because of this parasitic plague. Secondly, it is a conspicuous disease, and during a half of the

year when the trees are defoliated the knots can be found without the least difficulty. Any attempts to shield the trouble, on the part of the owner, would be fruitless, even if he should care to preserve the curse. In the third place, the remedy is the very heroic one of the knife, and easily, safely and with certainty applied. There may be some compounds put upon the diseased parts that will kill the fungus, but it is so deeply seated that when a twig is thoroughly infested there is little left for the fruit grower to do but cut away and burn the black excrescences. If a tree is badly attacked, the wisest method is to cut down bodily and destroy it by fire. Finally, when once the old knots are cleared out it will be an easy matter to keep the fungus from gaining a fresh foothold.

"There are many trees which are literally covered with knots and have been for years; trees which bear no fruit and never will, and they are worse than mere monuments of carelessness, for they propagate and perpetuate a disease that renders plum raising almost an impossibility in their neighborhood. Sometimes these old, distorted trees are upon the roadside, where any passing lad can pull off and carry to his own home one of these malformations, to become a new center of infection. But these knots do not need to be transported to produce infection, for the millions of spores developed in the spring, while too small to be seen, pass long distances with the winds, and thus spread the disease.

"There are several fungous diseases against which the State legislatures or the national Congress might pass enactments fully as wholesome and beneficial as those for the control of the diseases of animals, but few of them offer so many favorable points for successful legislation as the black-knot—the scourge of plum and cherry growers in many localities. The law should include, to be effective, all wild plum and cherry trees that are breeding places of the pest."

We have already a law preventing the spread of new fungous diseases, which was approved last May, and for the information of those most interested it is given below:

"AN ACT TO PREVENT THE SPREAD OF FUNGOUS DISEASES OF PLANTS.

"WHEREAS, The officers of the State Agricultural Experiment Station have discovered certain new fungous growths that threaten serious injury to important agricultural interests of the State; therefore,

"1. BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey*, That when the officers of the State Agricultural Experiment Station shall discover any new fungous growth which is doing injury to plants or vines, and while the same is confined to limited areas, they are hereby authorized and empowered to enter upon any lands bearing vines or plants so affected, and destroy the same by fire or otherwise, as they shall deem best.

"2. *And be it enacted*, That any damage to private property resulting from the operation of destroying the said fungous growth by the officers of the State shall be certified to by them, and the amount of damage paid to the owners thereof, from the same fund and in the same manner as is paid to owners of diseased animals killed by order of the State Board of Health.

"3. *And be it enacted*, That expenditures under this act shall not exceed one thousand dollars in any one year.

"4. *And be it enacted*, That this act shall take effect immediately.

"Approved May 23, 1890."

It will be seen that this does not cover the case of the black knot, which is an offender of long standing. Besides, this pest is of such a nature that any considerate person interested in the fruit industry of this section could scarcely wish for any compensation from the State for using every possible effort to check if not eradicate an enemy that can be so easily found and so quickly dealt with as the black knot. If, however, the desired end cannot be reached by an earnest appeal to the good sense of the farmers and fruit growers of the State, there remains possibly the effective impulse that can come from legislative enactment.

What needs to be done is to remove the black knot from the orchards and gardens throughout the State. If there are only a few isolated excrescences here and there upon the plum and cherry trees, the importance of removing these is still great, for they are seats of a contagious disease that constantly gains ground through any delay. Should the tree be badly infested and practically worthless, let it no longer encumber the ground. Let all such be cut down and burned at once. Seek out any knot-bearing plum or cherry tree, wild or tame, that stands in the highway or fence-row, and cut and burn it. The loss of the tree or shrub, as such, will be as nothing when compared with the gain in choice fruit in the future. Last, but not least, pass through the wood lot with ax in hand, and destroy every specimen of choke cherry or other knot-bearing relative that may be lurking there. Last of all, take an active interest in the matter outside your own domain, and if possible see that your neighbors upon all sides do as you have done. This is nothing more than your duty that is here brought to your notice.

Nurserymen above all others should be attentive to the instructions here given. Whole rows of young plum trees, for example, may be diseased, the infection coming to them from older knotty trees in the nursery or from wild species growing in the fence-row or woodlot near by. When such stock goes out the disease goes with it, and perhaps to localities previously exempt from the trouble. While, therefore, watchful for the knots upon the trees at home, the fruit grower should bear in mind that he needs to set young trees that are free from the fungus.

Finally, the hope is indulged in that this appeal will be met in the kind spirit in which it is made, for it is only a desire to further the fruit interests of New Jersey that prompts it, and the manifest need of something being done to meet a growing enemy, and that at once. The comparative leisure of the winter days offers a most appropriate time to seek out the black knots of plum and cherry trees, wild as well as cultivated, in woods as well as orchards, and burn them. Let the cleansing agencies of pruning knife, ax and fire be applied wherever the conspicuous enemy to two of our best fruits can be found.—*Bulletin Ag. College Exp. Station.*

[Continued from SUPPLEMENT, No. 796, page 12726.]

JUBILEE OF THE CHEMICAL SOCIETY OF LONDON.

PRESENTATION OF ADDRESSES.

DR. JOHN EVANS, treasurer of the Royal Society, being called upon, said that as he, as treasurer, and the two secretaries of the Society were present, it was thought unnecessary to present a written address. As the parent society of all the learned societies, the Royal Society took great interest in each branch of science, and they would be wanting in interest if they had not been there that day to congratulate the Chemical Society on their fiftieth birthday. Dr. Evans then proceeded to speak of some of the things that the Royal Society has done for chemistry, its association now with Sir John Lawes' Trust, and after general and rather commonplace remarks about the progress of chemistry, in the name of the Royal Society congratulated the Chemical Society on its brilliant past, and tendered good wishes for the future.

Mr. Carteighe read the engrossed address of the council and professors of the Pharmaceutical Society. It was a remarkable address, recalling the fact that the Pharmaceutical Society was founded on April 15, 1841; some of the most important members had been fellows of Chemical Society, and the Pharmaceutical Society's charter of incorporation, granted in 1843, mentioned one of the purposes of the Society as the promotion of chemistry. One of the founders of the Chemical Society, George Fownes, the assistant of Professor Graham, was the first professor of the Pharmaceutical Society, and Professor Redwood, his successor, had been treasurer, secretary, and a vice president of the Chemical Society for many years. The address went on to speak of the research laboratory, which is mainly devoted, it was stated, to the promotion of chemistry in its higher branches, as well as to pharmacological research, and concluded by wishing continued prosperity to the Chemical Society.

Dr. Russell, in his reply, said they all felt how nearly the two societies were associated, and hoped that the connection between them would be long continued.

M. Gautier, of the Société Chimique de Paris, who was received with loud applause on rising, then addressed the meeting in French. M. Gautier regretted his inability to make a speech in English, and declared that he had found additional cause that day to deplore the incompetence of his knowledge of our language, inasmuch as he had experienced great difficulty in following the various speeches which had been delivered. But if he was unable to speak to them in their own tongue, he could at any rate assure them that no more congenial duty could devolve upon a French *savant* than that of doing homage to a British fellow scientist. Even from before the commencement of this century there had existed between French and British men of science a specially strong bond of sympathy. He had always found his British friends exceptionally well informed on all matters connected with the progress of science in France, and in that country they greatly admired the admirable manner in which English journals kept abreast of all that transpired in French scientific circles. Moreover, although himself more especially connected with the theoretical side of chemistry it was impossible for him not to remember that the advancement of the practical branch of that science in particular was in a very great measure due to English chemists and men of science. In congratulating the Chemical Society most heartily upon the attainment of its jubilee, and in wishing it, in the name of the chemists of France, a still more prosperous and brilliant future, he begged to thank them most heartily for the hospitality extended to his compatriots by their English *confreres*. He was commissioned by several of his colleagues and co-scientists, among whom he might mention MM. De Clermont, Haller, Friedel, and Combes, who asked him to convey to the Chemical Society the assurance of their regret at their inability to be present at its festival. His illustrious compatriot, M. Pasteur, desired especially to express his disappointment that the state of his health precluded him from being present in London on that day, and M. Berthelot, he knew, was only prevented from being there that day by the fact that he found it impossible to tear himself away from his duties as a member of an important commission, appointed by the French Ministry of Public Instruction, and as a Senator. In conclusion, he begged to assure them again of the happiness which the learned societies of France experienced in being able to wish to the British Chemical Society success and prosperity, and to seize this opportunity of assuring them of the high esteem in which that Society had always been and should ever be, held by its French sister organizations. (Cheers.)

Dr. H. Will, of the Deutsche Chemische Gesellschaft, then, after a few sentences in English, read an address in German on behalf of the society represented by him. Dr. Will read from a copy of the address, the original being a magnificent work of art by the celebrated German painter, Röhling. The title page was pictorial, including symbolical female and infantile figures, and the text was beautifully illuminated in Old German character. The cover was an excellent specimen of the binder's art, the outside being in embossed leather, lined inside with figured silk. The document stated that among the large number of learned corporations which were on this occasion testifying to their esteem and admiration of the Chemical Society, the Deutsche Chemische Gesellschaft also desired to take its place. The name of Thomas Graham was honored not only in Great Britain, but far beyond its borders. The address then proceeded to contrast the condition of chemical science at the time of the founding of the Society with that of the present day, and referred to the growing power and commercial importance of the British colonies and the increasing attention given in those parts to the study of chemical science, and of the societies springing up in these young countries and in America for the purpose of furthering the study of the science to which they were devoted. In Germany also the society which he represented had contributed its share toward the development of the science and toward industrial chemistry. In conclusion the hope was expressed that after another period of fifty years the Society might be able to look back upon an equally bright record of work accomplished, and a roll of names as illustrious as that which graced the record of the first half century of its existence.

The next speaker was Dr. Holtz, representing the German "Verein zur Wahrung Chemischer Industrien," who, also reading from a German manuscript, offered to the Society the congratulations of the corporation represented by him. In doing so he pointed out that the technical and the scientific branches of chemistry were indissolubly linked together. In the course of time other countries, it was true, had witnessed the foundation of independent chemical industries on their soil, but still to Great Britain belonged the honor of having been the spot where the great chemical industry was created and cradled. The part she still played in that industry, and a long array of names of illustrious British investigators enshrined in history, imposed it upon the German Union of Chemical Industries as a pleasant duty to send its representative to England on this occasion to offer, in its name, its hearty wishes for the prosperity and glory of the Chemical Society. The speaker then briefly reviewed the rise and development of the British alkali industry, the paraffin industry—now also firmly rooted in Germany—the investigations in the domains of hydrocarbons and ferments, and the "brilliant industry of coal tar dyes," which, originating in this country, has now attained such enormous dimensions both in Germany and in Britain. He concluded by saying that no greater advantage would accrue to the chemical investigator than to be versed in the processes and inured in the methods of study of chemistry of both Germany and Britain, and that happy indeed was he who, in addition to that knowledge, had enjoyed the hospitality extended in the imposing halls of Burlington House.

Professor Armstrong then read the address from the Russian Physico-Chemical Society, which was printed in Russian and English. The address stated that the society sent to its oldest brother society, the London Chemical Society, its most heartfelt congratulations on the fiftieth aniversary of its foundation. An unbroken chain of glorious names of British chemists, it proceeded to say, is a certain pledge that, in the future as in the past, England will retain its foremost place at the head of scientific progress, to the glory of universal science, and the welfare of mankind. The address was signed by Mendeleef. Thereafter Dr. Armstrong mentioned that telegrams and letters of congratulation had been received from Dr. Von Bayer on behalf of the Munich Chemical Society, from the societies at Frankfort, Upsala—indeed, from all parts of the world. The meeting then adjourned.

THE SOIREE.

Half-past eight was the hour fixed for the reception at Goldsmiths' Hall, but calculations were made without the fog, and at that hour Professor and Miss Attfield were taking the place of the president in receiving guests. It is not possible to do justice to the exhibition of apparatus and chemicals in a short notice. There were specimens to show what famous chemists worked with, and what they made; and there were collections by living fellows of the Society which might themselves be taken as a proof of the great advance which science has made in the century. For instance, one could not help contrasting the pair of scales which belonged to Scheele, and which he gave to his pupil Orfila, with the modern chemical balances which have assisted in redeterminations of atomic weights—even those used by Davy and Young. Scheele's scale pans were no bigger than a crown, not any better than what one puts in a ship's medicine chest now, and the case would pass for a spectacle case. There was a very curious balance in a rough wood case, made by one Harrison for Henry Cavendish, and given to Davy by Lord George Cavendish in 1830. This was the one that Cavendish used in his physical and chemical investigations. There were some of Dalton's home-made apparatus, and excellent old engravings of Boyle's laboratory in Southampton Street, Covent Garden, where Ambrose Godfrey Hanckwitz worked, and which up till 1862 was used by Messrs. Godfrey & Cooke. The engravings belong to Mr. Joseph Ince, and were part of a collection brought together by Professor Dunstan, there being also a specimen of phosphorus made by Hanckwitz about the year 1680. At the time when this phosphorus was prepared Hanckwitz was Boyle's assistant, and he obtained it from urine by the method described in Boyle's posthumously published paper (Phil. Trans., 1693). For many years subsequently Hanckwitz was the only manufacturer of the substance in Europe. He claims to have been the first to obtain the element in a solid "glacial" form (*phosphorus glacialis urinæ*). In the account (Phil. Trans., 1733) which he gave of his method to the Royal Society in 1733 it is stated: "An operator that is not well versed in the degrees of fire, and does not know how and when to take away these oils apart, will have nothing but a volatile salt and fetid oil, and get at least only a little unctuous opaque phosphorus; such as the famous Kunckel, Dr. Krafft, and Brandt did, as they acknowledged in their writings, but not our hard transparent phosphorus."

There were a good many specimens from the Pharmaceutical Museum, and the chief public collections in the country were drawn upon for the occasion.

Sir John Herschel's first attempts at photography were shown by Professor A. S. Herschel. They are not bad photos now, though it is fifty-two years since they were taken, and this is how Herschel describes the process in his MS. journal of chemical experiments:

"Having precipitated muriate of silver in a very delicately divided state from water very slightly muriated, it was allowed to settle on a glass plate; after forty-eight hours it had formed a film thin enough to bear drawing off the water very slowly by a siphon, and drying. Having dried it, I found that it was very little affected by light, but by washing with weak nitrate of silver and drying, it became highly sensible. In this state I took a camera-picture of the telescope on it. Hyposulphite of soda then poured cautiously down washes away the muriate of silver and leaves a beautiful delicate film of silver representing the picture. If then the other side of the glass be smoked and black varnished, the effect is much resembling daguerreotype, being dark on white as in nature, and also right and left, as in nature, as if on polished silver."

Photography, indeed, was well represented in the

exhibition. Warren de la Rue's first attempts on the moon being shown, and there was an interesting group showing how drawings made with fluorescent substances, such as quinine, which are invisible to the eye, but are caught and recorded by the sensitive plate just as if they were black. Faraday, Graham, Brodie, Warington, Joule, Thomas Thomson, Fownes, were all brought to mind again in exhibits of apparatus which they had used or chemicals they had made, Warington's memory especially being recalled by the presentation album and early photographs and daguerreotype. Most of the presidents of the society still living sent specimens to illustrate their life work. "Ah! there's Frankland's old digester," said Professor Attfield to our reporter; "many a time I have used it." It was the one employed in the production of organo-metallic compounds in 1850, and it had a place on Tuesday night beside a score of interesting organic compounds. Sir F. A. Abel, Sir H. E. Roscoe Dr. Perkin, and Dr. Müller showed compounds made by them; but Mr. Crookes had the palm for variety and beauty of show, his specimens representing forty years of personal work in chemistry and physics. Dr. Perkin's collection of organic compounds was exceptionally fine, and there was a great deal of interest shown in the exhibits by Dr. J. H Gilbert illustrating the work at Rothamsted by Sir John Lawes and himself. Nor should we forget to mention that in one of the reception rooms there was a collection of photographs of past presidents and leading fellows of the Society, which appeared to be appreciated. In fact, the whole affair was exceptionally brilliant, and those who were there appeared to think so, and to enjoy it—thanks to the secretaries, Professors H. E. Armstrong and J. M Thomson.

The jubilee dinner was a great occasion, unquestionably. There were 230 gentlemen present.

THE JUBILEE SPEECH.

Dr. Russell said he felt his position an embarrassing one, for, with the Marquis of Salisbury on his right hand, the attorney-general on his left, and in the presence of 230 fellows of the Society, it was not easy, in a 15 minutes' after-dinner speech, to review fifty years' progress of science They claimed that in 1841 chemistry was a sufficiently broad science to require a distinct branch of its own; and so the Chemical Society was formed, and that at the right time. He attributed much of the awakened interest in chemistry at that time and the early progress of the Society to Liebig, whose school at Giessen, and the 240 papers which he published, drew students from all parts of the world. Among these students was Lyon Playfair, who, coming back to England full of enthusiasm about Liebig and chemistry, imbued others with his enthusiasm, and even went to the north of England and told the calico printers of Manchester they did not understand their business—that they wasted their colors, and that economy of material and brilliancy of color would be assured by their studying Dalton's atomic theory. (Laughter.) Then the president proceeded to tell how the College of Chemistry was founded and became a small Giessen in Oxford street in 1845. Here came Hofmann to teach, and to him Dr. Russell attributed the great interest and progress which chemistry shows from that date. Allusion was made to the work which Dumas, Gerhardt and others were at that time pursuing, and the researches of Frankland. Williamson and Odling were also spoken of, and their influence upon the science shown. Up till 1848 nobody troubled themselves about the simple hydrocarbons, but then Mansfield showed how to obtain benzine from coal tar. This was the starting point of the remarkable achievements which have been made in organic synthesis, and in which Dr Perkin has done so much work for art and beauty. Passing on to considerations of the abstract side of the science, Dr. Russell referred to the discovery of the periodic law; the labors of Kirchhoff and Bunsen on the spectroscope, which might be regarded as the most important discovery of the latter half of the Society's life; and reference was also made, amid applause, to Crookes life work. But, in concluding, he took the synthetical branch of chemistry as furnishing a striking answer to the question, What had the chemist done during the last half a century? How little could the twenty-five chemists who founded the society fifty years ago have imagined what the knowledge of to-day would be! To-day they were equally unable to predict the chemistry of fifty years hence; but what they could with certainty predict was that, great and rapid as the progress of their science had been during the last half century, still more important and still more rapid would be its progress in the time to come. (Cheers.)

THE PRIME MINISTER ON CHEMISTRY.

The Marquis of Salisbury on rising was received with loud cheering. He said he had been, though most unworthy—(no, no)—selected to propose the next toast, namely, "Prosperity to the Chemical Society." (Cheers.) It would have been better, he thought, if it had been placed in the hands of some one who knew more about it, but they would not excuse him, so he would proceed with his task, hoping that his distinguished friend Sir Lyon Playfair would supply that knowledge which they might perhaps find lacking in him. What struck him was the importance—the enormous importance—of the science they cultivated to the community as a whole. About a hundred years ago the president of a celebrated tribunal, who was a man of rather advanced opinions, informed Lavoisier that a republic had no need of chemists. (Laughter.) But, though a man of advanced opinions, he was behind the age. (Renewed laughter.) It was the beginning of the time when chemistry more and more, as each decade rolled by, asserted its vital importance to every class and every interest in every community in the world. He thought—if it was possible to pass any criticism upon the learned and able and most interesting discourse to which they had just listened—that the president was a little too apologetic for chemistry in the first half of the century. Annals which contain the names of a Davy and a Faraday they had no reason to be ashamed of. (Hear, hear.) But from the social point of view chemstry undoubtedly has this claim—that it is one of the most powerful agents that have moved the world. There was no need for him to tell what Roger Bacon and Volta had done in the education of the world. It seemed to him that, as an educational instrument upon the minds of the community, chemistry is one of the most valuable that we possess, because more than any other science it is brought into close communion with pure, real facts. Science is a word that is elastic in our days. We hear many definitions given of it. We hear of the scientific imagination—a most valuable quality that he would be the last to depreciate, only he thought that, like many valuable and concentrated essences, it ought to be indulged in in small quantities. (Laughter.) There is a proportion in its admixture similar to what Falstaff observed in his mixture of bread and sack; one felt a desire for more of the solid nutriment, and less of the stimulating spirit. (Laughter.) Now, chemistry has an enormous amount of the bread, and very little of the sack; it has an enormous amount of the solid fact, and very little of the scientific imagination, because the chemist can always be certain of the discoveries that he makes. All that he has got to do, if he is in doubt, is to repeat his experiment, and thus he can make sure of the effect of his discovery. But, of course, when a man discovers what happened fifty millions of years ago, it is not so easy to be exactly accurate as to the nature of his discovery, and when a man discovers what is going on fifty billions of miles away, although the discovery may be probable, it certainly has not the character of certainty that attaches to the discovery of a man who can go back to his laboratory and repeat his experiments.

Astronomy, continued the noble marquis, is largely composed of the science of things as they probably are, geology consists mainly of the science of things that probably were a long time ago—(laughter)—and chemistry is the science of things as they actually are at the present time. (Applause.) The application of a science of that kind to the national mind by constant familiarity with its teachings, by constant knowledge of its achievements, is of the very highest human value. (Hear, hear.) It teaches the mind the immortal difference between guessing and knowing, and the further chemistry goes, and the more it asserts the superiority of its laws and canons in all departments of human thought, so far we shall drive guessing to a distance and be satisfied with knowing what we can know. But his task was to say something about the Chemical Society, and perhaps the most suitable course he could take, following their distinguished chairman, was to take the opposite side from what he took—(laughter)—because that would give at least variety to our proceedings, and would give them an opportunity of testing the superior value of Dr. Russell's remarks. He had dwelt much and dwelt most fairly and justly upon the enormous value, from the material point of view, which chemistry has been to society in the rapid development that has marked the present reign. He was far from disputing its splendid services to the people of all Europe during that period; but he did not think it is for the purpose of securing those services that the Chemical Society exists. (Hear, hear.) His right honorable friend did quite right to go down to Manchester to stir them up and show them their business. But when that impulse has been once given, the self-interest of mankind might be trusted to keep themselves up to the mark, and one may be sure that the material interests of chemistry will not suffer in the cause. There are higher aspects of chemistry which it is the function of societies such as this to remember. It is our duty to keep up its intellectual spirit—to teach that not only those things which are demanded by the interests and industries of this country ought to be cultivated, but also those things which carry us nearer to the essence of truth. (Cheers.) He was not going to carry that pretension too far. We are beings of a mixed character, and our pursuits must bear the trace of the mixture which we give to them. Nor would he imitate the Oxford professor of his youth who said that the one thing he valued in the system of quaternions was that he was perfectly certain that it could never be defiled by any utilitarian application. (Laughter.) Still, it would be observed that the industrial part of chemistry has been that which has received the highest development. Their distinguished president gave a touching and pathetic history of what he might call

THE LOVES AND VICISSITUDES OF BENZENE.

Why has she been lifted up among so many of her compeers in the chemical lists with formulæ quite as imposing and histories quite as difficult to follow? It is because the products that have been drawn from benzene, or at least from coal tar, have had the good fortune to produce colors which engage the female eye (laughter and applause), and therefore it is that benzene is famous. (Laughter.) He pleaded for her humbler sisters who have produced no colors, but the study of whom might yet lead up by steps to the discovery of mighty laws and phenomena which will interest the world; and this, in his judgment, is one of the advantages of such a society as that; it tends, by bringing men of different research and pursuits and of different intellectual qualifications together, to prevent the science from becoming, as it has been called, the mere "handmaid of industry," and secures that its higher claims shall receive a perpetual recognition from its votaries. (Cheers.) Their distinguished president had prophesied great things as to the future that awaits us, and he himself believed that there is plenty of room for discovery in the future, and that our fathers have by no means monopolized or exhausted the glories our descendants may yet win; and he had the feeling that looking at what science is and what science has achieved, it is rather like an Alpine prospect in the early morning, when you see here and there a few peaks bathed in light, but separated from each other by depths and chasms of the unknown. (Hear, hear.) That is what we all of us feel who look with very little skill or very superficially at the history of science in our own day. It is evident that chemistry is entering upon a new state, in which it may win splendid victories and produce results of which our forefathers never dreamed. Perhaps it would be best to describe the difference between chemistry now and chemistry as it was when he was a young man, by saying that in those days the atom reigned supreme, but that now the atom has been dethroned and the bacillus reigns in its stead. (Laughter.) But that means that we approach, with more and more chance of solving it, the vast problem which separates organic and inorganic nature. Their president had claimed that nature has no longer the monopoly of creating organic substances. That is true, but nature still does many things which none of them could do—(laughter)—and still less could they tell him the reason of the vast difference between organic and inorganic nature. They were all most familiar with the tremendous vegetable poisons which produce the most fearful and astounding effects upon the human frame, but if he asked them to explain their effects they could only show him the formulæ of most vulgar and commonplace elements—(laughter)—which give no explanation whatever of the tremendous powers those poisons have. Agriculturists, under the guidance of Dr. Gilbert and others, compass sea and land in order to bring manure to make our products grow. What is manure? Why, it is an impure form of the carbon and nitrogen in which those products are bathed in the circumambient air every day of their lives. He hoped that the chemistry of the future will tell us why we have to go to Chili for these things—(laughter)—and why we cannot take them from the air around us. He believed that these and other problems are now approaching nearer to their solution than they have ever approached before, because we have seen chemistry grapple more closely with the mysteries that separate organic and inorganic life. He believed that in the future, some fifty years hence it may be, in that or in some other room, the president of the Chemical Society of that day would congratulate the associates on victories, on achievements of which they could not now even dream; and he was quite sure that when that was so, the president of the day would attribute no small share of the progress to the labors and existence of the Chemical Society. (Loud cheers.)

Sir Lyon Playfair, in replying to the toast, referred in graceful terms to Lord Salisbury's presence, and to the fact that he is a bit of a scientist himself, although not the first one among the nobility, for there were also the illustrious Boyle, "the father of chemistry and brother of the Earl of Cork," and Cavendish, who discovered the composition of water, and founded the methods of accurate investigations by weight and measure. Proceeding to speak of the progress of chemistry during the past fifty years, Sir Lyon Playfair humorously alluded to the tendency of the elements to give up all their old traditions. Oxygen used to be a sort of universal lover among the elements, and nitrogen a quiet, confirmed bachelor. But now oxygen was a respectable bigamist that only married two elements at a time; while the indifferent nitrogen, which behaved so meekly in our atmosphere, whenever it got out of it was so polygamous that it generally required three conjugates, and sometimes took five at a time. In fact, Hofmann and Perkin had corrupted altogether the morality of the nitrogen of his youth. (Loud laughter.) He spoke of Curtius and Radenhausen's production of azoimide, and gave several instances to show how greatly our ideas regarding valency have changed since 1841, and although, he said, he had been chaffing, he fully appreciated all the splendid results which had followed from the examination of the valency of the elements. As an original member of the Society, he trusted that the next fifty years would produce as great results as those which had been attained since it was founded.

SCIENCE AND INDUSTRY.

The attorney-general, in proposing this toast, said he would have been glad if he had been able to associate with the toast the name of one of the five remaining fellows, Sir William Grove, whom he had known from his childhood, and had read his works. He thought he would tell them how science affected eminent lawyers. Many years ago he had to attempt to get a patent for a certain carbolic red, and he had to go before that eminent chancellor Earl Cairns to argue his case. For many nights he tried to master the subject, and a distinguished chemist, sitting not far from him (? Sir H. Roscoe), came to his chambers and gave him an hour and a half on the subject, at the end of which he (Sir Richard Webster) said: "Don't give me any more, I am saturated." (Laughter.) But it did not stop there; he was put in a cab with that chemist, who eagerly kept his eye on him to see if there was any sign of effervescence. (Laughter.) Then he got before Lord Cairns, who listened to him in astonishment, and at the end of twenty minutes said: "Mr. Webster, your chemist will have his patent; but I hope if anything arises from this, and the matter is carried further, the tribunal will retain its reason to the end of the chapter." (Laughter and applause.) With the toast he coupled the name of Sir H. Roscoe, who, he said, was not done with his researches yet, for during the investigations which had been made with a view to discover the best means of excluding the fog, he was told that a very remarkable collection of microbes had been found, threatening danger to the members of the House of Commons. (Laughter.) He would take them into his confidence and tell them that to the peculiarities of these microbes and the best way to prevent them from entering the House, Sir H. Roscoe was about to devote his personal attention. (Laughter and applause.)

Sir H. Roscoe was received with cheers when he rose to reply. His speech, which was read, was devoted to showing how science has remodeled almost every condition of life. He claimed that the Chemical Society, and other societies like it, had been of great benefit to industry, and, therefore, to the public.

INTERNATIONAL COMPLIMENTS.

Professor Frankland was received with an exceptionally hearty outburst of applause when he rose to propose the toast standing in his name. He said that the example shown by England in establishing a Chemical Society was followed in France thirty-eight years ago and in Germany twenty-five years ago. If the latter was not actually smuggled into Germany by Hofmann, he at least took the idea with him when he went back to Germany in 1865. Hofmann had been one of the most active members of the Society, and they were glad to welcome there that night representatives from both countries, and he was pleased that they had heard from the United States that night. Victor Meyer's name he mentioned amid loud cheering, and, in addition to the names of those who responded to the toast, he paid a special compliment to the society represented by Dr. Holtz.

M. Gautier, replying in French, said when he commenced to study chemistry, thirty years ago, the names of Davy, Dumas, Liebig, and Berzelius were most frequently recurring. Among novelties were the beautiful works of Williamson on etherification, of Frank-

land on the organo-metallic radicals. Little did he then expect to have the honor of responding to a toast proposed by the latter in this happy England, and in the presence of the noble lord who had been good enough to join in this *fete*. Might he hope to meet them all in Paris when they should celebrate the jubilee of their Chemical Society, which dated from 1858. M. Gautier proceeded to speak of the pacifactory work of science. He had spoken of his feelings toward England on the previous day. He would like to take advantage of the occasion to say how highly they esteemed the work of German *savants*, and how greatly they admired the scientific investigations of Germany's great men. Science, it had been said, had no country. Men of all nations could work together in its service for the common good

Dr. Will also replied, in German, thanking Professor Frankland for his friendly speech, and observed that the successes of science were open to the whole world, and without limitation of any kind. No better illustration of the broad and international spirit which animated scientists could be found than in the work of the Chemical Society during the fifty years of its existence. Dr. Holtz and himself had been appointed to represent the German chemical societies, for Professor August Kekulé, president of the Chemische Gesellschaft, and Prof. Hofmann, the vice-president, were prevented from being present by unavoidable duties, but they asked him to express their congratulations to the Society. He was proud to be able to express the general wish of German chemists that the friendly relations between the societies of the two countries might be maintained, and be fruitful of further benefit to science.

Sir F. Abel, in proposing the next toast, spoke of the achievements of Victor Meyer; but he had scarcely commenced when the audience spontaneously cheered, most of them upstanding. That, Sir F. Abel said, relieved him of the necessity for using eloquent words, for the cheering showed how they liked the man. He also referred to what the guilds of London had done for science, coupling with the toast the name of prime warden of the Goldsmiths' Company in the absence of Sir Andrew Clark.

Professor Victor Meyer rose, but it was a minute or two before the cheering allowed him to proceed. He spoke most effectively in his native tongue, and referred feelingly to the great hospitality which had been shown to him; and speaking on behalf of the foreign members of the society in Heidelberg, said that Bunsen and Kopp regretted that they could not be present to personally congratulate the Society. He also alluded gracefully to the fact that Frankland and Roscoe, having studied in Bunsen's laboratory, had returned to England, and richly repaid science generally for what they had gleaned from their Continental studies, Frankland by his research on zinc ethyl—a most important factor in organic synthesis—and Roscoe by his work on vanadium, and by his text books, which were still used by the German students.

Kekulé also owed much to England; it was a fact that the idea of constant valency first occurred to him as he was rolling through the streets of London on an omnibus. Hofmann, in founding the Deutsche Chemische Gesellschaft, modeled it upon the same principles as the English society. He concluded by expressing the wish that the international work of the Chemical Society in London might continue to flourish forever.

Mr. Carteighe's toast was the next. He said he did not understand upon what principle he had been selected to propose the toast, but he regarded it as a special honor to the Pharmaceutical Society. He thought that all that had preceded should be taken as reflecting upon the past presidents, and he would confine himself to the present one—Dr. Russell. Again referring to the honor done to him, Mr Carteighe proceeded to speak of his association with Russell in the Birkbeck Laboratory of University College, where Dr. Russell was assistant to Graham; and he recalled with pride the honor done to him (Mr. Carteighe) when Professor Graham asked him to examine the first known specimen of pure glycerine. He then proceeded to speak of Dr. Russell's work as a teacher and investigator, of the work of the Chemical Society, and reminded the meeting that many of the leading fellows in the past as well as the present were indebted to pharmacy for their early knowledge of the science. Finally he thanked the meeting for allowing him to propose the toast, asked them to drink it upstanding with three cheers, and complimented Dr. Russell on the manner in which he had conducted the jubilee.

Dr. Russell replied briefly, but apparently with much feeling, and thus ended a celebration which few that have taken part in will forget.—*Chemist and Druggist.*

THE PEACH YELLOWS.

THE yellows of the peach is spreading in Western New York, and is becoming a very serious menace to peach culture. Investigation into the nature of this disease has been carried on for the last three or four years by the Department of Agriculture at Washington. Little has been said concerning these investigations, and people are not aware of the extent to which they have been carried. In order to learn something of their scope, I visited the Chesapeake Peninsula in October and examined the field experiments under progress. Dr. E. F. Smith is the special agent of the Department of Agriculture who is investigating the disease. In this region he has eighty acres of orchard under direct experiment, forty of which, scattered through twelve orchards in Delaware and Maryland, are devoted to fertilizer tests. These fertilizer tests are above a hundred in number, and comprise treatment with nitrogen, potash, and phosphorus, and many combinations of them. He has tried all of the fertilizer remedies which have been recommended for the cure of the disease and for its prevention. These have been tried upon all kinds of soils, and upon trees of all ages. They have been used with exceeding care, and they comprise the largest field experiments of this nature, upon diseases of plants, yet made in this country. It is evident upon examining these orchards that there is no fertilizer nor combination of fertilizers which will either cure or prevent the yellows. Many of the fertilizers, especially those rich in nitrogen, have a wonderful effect upon the vigor of the tree, but they do not prevent the yellows, nor cure it. All the investigations so far made go to show that yellows is a specific disease, entirely independent of soil or surroundings.

Many investigations in other directions have been made, and many important facts have been obtained concerning the nature of the disease, but so far its cause has not been determined. The disease is an exceedingly obscure one, much more so than pear blight or any other disease with which we are familiar.

The New Jersey, Delaware and Maryland orchards are being rapidly decimated with the yellows; in fact, the uppor portion of Delaware is practically devastated of peach trees, and the upper part of the Chesapeake Peninsula in Maryland is no longer a profitable peach region. There are acres upon acres of orchard in which more than every other tree is visibly diseased, and in large areas is almost impossible to find a single healthy tree. There has been very little united attempt toward controlling the yellows in these regions, and for that reason this present destruction threatens the industry. It is useful to compare the results in this region with those of the Michigan peach region, where a definite law was early enacted and which has been enforced vigorously. In Michigan the yellows is on the decrease and the planting of orchards is on the increase. In Maryland and Delaware, the yellows is rapidly on the increase and orcharding is mostly on the decrease. The only remedy so far known is eradication of the tree as soon as the disease is seen. The disease is constitutional, and even when we have found the cause it will probably remain incurable. Yet there is no reason for undue alarm in the matter, because the experience of the Michigan growers has proved conclusively that radical measures will keep the disease in check or almost eliminate it from any country. The New York law is essentially the same as the Michigan law, and if it is rigidly enforced by healthy public sentiment, there is no reason why peach culture should not flourish. Otherwise, sooner or later our peach industry must perish.—*Cornell Station Bulletin.*

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